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CANADIAN MINING & MECHANICAL REVIEW.

(Formerly THE CANADIAN MINING REVIEW.)

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

OFFICES:

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The Outlook for Phosphates.

The feverish excitement attending the discovery of large phosphate beds in Florida has now somewhat abated, and the facts of the case have become pretty well known, through the published investigations of competent and conscientious experts. It is, therefore, possible to look over the situation with calmness, and to gauge with some degree of accuracy the effects of this new source of supply upon the markets of the world. Among the first questions that present themselves in this regard are those relating to the nature, occurrence and composition of these phosphates and the manner in which they differ in all these respects from the Apatites of our own country; and, although various answers have been suggested by different authorities, the most reliable conclusions can now be drawn from industrial and commercial results. It is necessary in approaching this subject to remember that the phospates of Florida are of two kinds—RIVER and LAND—and it will save some confusion if we at once point out that it is only with the latter that we Canadian miners of high grade apatites need concern ourselves. The gravelly or nodular of the Florida river-beds, or swamps, will bear no comparison with our product for many reasons; the chief being that their percentage of phosphoric acid is too low, and their percentage of iron and alumina far too high to meet the requirements of manufacturers of water-soluble superphosphates. The actual cost of raising them to the surface is represented, and perhaps truly, as being very low, but this is more than counterbalanced by the scarcity of labor and the lack of facilities for transportation; and we are therefore justified in regarding them as a species of gigantic reserve, to be called upon by future generations of farmers when the beds of the well known, equally cheap and accessible, and more esteemed material in South Carolina have begun to languish. According to Dr. Francis Wyatt, the geological formation of the "land" or "rock" phosphate is superposed upon a foundation of much-fissured Upper Eocene limestones, and is made up of extremely irregular pockets, or banks of siliceous, marly, and phosphatic material heterogeneously jumbled together. The pockets are sometimes of immense extent, and at others of only very narrow dimensions. The banks consist principally of boulders, rolled up by the action of water and cemented together by a siliceous mud, hardened by evaporation and exposure. This description being applicable to the entire State, it follows that the Florida phosphates, like those of similar origin in other parts of the world, are nothing if not capricious, uneven and deceptive. As an illustration which we may very fairly consider typical of this uncertainty, we may refer to the published report of an expert chemist and engineer of New York, who was sent to Florida to examine a tract of 5,120 acres of land in the heart of what is called the "phosphate belt." The most attractive indications of phosphate rock were everywhere prevalent; sometimes in the form of huge boulders outcropping on the surface, and more generally in the form of small debris, brought up from below by the industrious male. A thoroughly systematic examination proved that the actual amount of land on the entire tract containing workable deposits of phosphates was only 83 acres, and that this area was not all in one piece, but was made up of small portions varying in size from a few feet to two or three acres. Their depth of phosphate-bearing sands and clays ranged from 15 to 30 feet, and the thickness of the phosphate deposit itself was from 3½ to 27 feet, the average, however, being no more than 8 feet. It was made up of about the following components:—

13 per cent. by weight of large and small boulders of 80% phosphate of lime.
29 per cent. by weight of debris and soft white matter of 60% phosphate of lime.
56 per cent. by weight of sand, clay, flints and waste.

The color, texture and specific gravity of the phosphate varied almost with every pit, and while in some of the beds the higher grades contained only a very small percentage of iron and alumina, in the majority of cases the output was heavily loaded with these injurious constituents. A careful estimate placed the yield at 5,000 tons per acre, of material having the above composition, so that we may reckon on some 650 tons per acre of about 75 to 80 per cent. grade. The desultory manner in which the pockets were scattered over the whole surface of the tract made it a matter of difficulty to place a fair valuation on the 83 acres of land which alone were of exploitable value. It was therefore necessary to acquire 5,037 acres of "dead" land, and to distribute the working over the entire body!

The inconvenience or impracticability—to say nothing of the cost—of establishing such widely distributed quarries, becomes obvious when we take into consideration the methods of exploitation. These phosphates have first to be dug out of the quarry and brought to the surface, carefully selected from the impure adhering matter with which they are connected, thoroughly washed in running water, and finally either dried in the sun or piled up and burnt in kilns! Every one of these operations requires skill, but there is still another of paramount importance which has still to be mentioned. We allude to the final process of selection for foreign shipment, whereby everything under 70 per cent. of lime phosphate, and exceeding 4 per cent. of iron and alumina oxides, are excluded from the piles. Without daily and accurate chemical analyses of the entire output, even expert miners go wrong in this last manipulation and blunders are found to be inevitable, all the more disastrous from the fact that the whole mining cost is thrown upon the higher grades. No market has yet been found for the immense quantities of second and third qualities, which must necessarily be taken from the pits, nor can we see the least chance in the near future of finding an outlet for them. In the first place, there are no facilities for their cheap transportation to points of consumption; and in the second place, they contain so much iron and alumina that in the ordinary process of manufacture no experiments have yet succeeded in making them sufficiently dry for commercial purposes.

These aspects of the question strike us as most worthy of attention, for they immediately suggest that Florida is hampered as a shipper of high grade phosphates by difficulties of great magnitude and importance. Before she can hope to justify her pretensions as a producer of the first rank, or to seriously and permanently influence our markets for good or evil, she must give more distinct evidence of her capacity than has been hitherto forthcoming. There can be no doubt that she is passing through the critical period of her history, and that those interested in agriculture and fertilizers are turning towards her with growing anxiety. This fact, however, only adds emphasis to the questions which have been so often propounded and are still unanswered: Where are her "Bonanza" deposits of high grade rock, and how are they to be exploited at a profit? For our own part we see no ground for the discouragement lately evinced by a few of our Canadian miners, and we do not hesitate to counsel those who have interests in our apatite deposits to preserve their courage and await further developments with confidence and composure. They will yet be called upon to witness the discomfiture of many unfortunates who have allowed themselves to be led away by exaggerated reports and excited first impressions. Florida is still, to a very great extent, an unsettled country; her climate is notoriously malarious in the phosphate belt, and she is subject, besides, to periodical and severe visitations of yellow fever. Her transportation facilities are imperfectly developed and wretchedly managed, and her railroad companies are poverty stricken and incapable of furnishing the rolling stock necessary for the extension of a great industry. Her people are speculative and enthusiastic, but are neither practical nor laborious, and while the negro, upon whom will fall the burden of the mining work, is an unoffensive, cheap and docile servant, he is shiftless and unreliable. We do not make these statements with a view to underrating the importance of a competitor. We are not so blind as to be unable to see the "Writing on the wall;" but we speak thus plainly because after mature consideration and minute enquiry we have concluded that Florida's resources have been grossly exaggerated. According to our information there is a yearly market in European centres for about *150,000* tons of phosphate of lime of 75 to 85 per cent. The buyers impose as a condition of their contracts, that the material

supplied to them for manufacturing purposes shall contain no more than three per cent. of combined oxides of iron and alumina, and they attach penalties to this condition sufficient to secure its observance by miners and shippers. Of the hitherto principal sources of the world's supply of phosphates, many are well known to be slowly but surely failing, and leaving Florida out of the question as a doubtful factor, it is difficult to predict where, if not in Canada, we are to look for increased contributions. If Florida does not fulfil what has been predicted for her, it will not, in any case, be from lack of opportunity, for within the last two years there have been incorporated no less than eighty odd companies for the purpose of wresting from her sandy bosom her presumed exhaustless phosphate treasures. Of this large number some will naturally prove to be merely ephemeral, and will disappear as suddenly as they grew, but there are others which are operated by men in the highest rank of science, industry, commerce and finance; yet what are the results thus far accomplished? They are not difficult to tell, and may be summed up in the brief statement that the total quantity of phosphate shipped to Europe, or in other words to our customers, from all parts of Florida since the commencement of operations in 1889, does not exceed 20,000 tons of an average quality not exceeding 75 per cent.

The Springhill Explosion.

This explosion, the third of the great coal mining disasters in Nova Scotia, has claimed for its victims one hundred and twenty-five men and boys. The collieries of the Cumberland Railway and Coal Company are at Springhill, in Cumberland County. Three seams are worked. The east seam slope, in which the explosion occurred, has reached a depth of 2,500 feet. At a depth of 1,900 feet, a level had been driven about 3,200 feet to the westward, and near the end of this level two counterbalance roads had been driven in the coal to the next level above, a distance of 600 feet. From these balance roads, horizontal workings, or bords, had been started and were being worked at the time of the explosion. About the middle of the workings, in the balance road furthest from the slope, the coal, about eight feet thick, was divided by two feet of stone into two benches five and three feet thick. The lower and thicker band only was worked. At points it was necessary to blow down some of the stone to allow the pit tubs to pass. The evidence showed very clearly that a shot had been fired at this point, in this stone, as the body of the man employed to fire the shots was found a few yards away. It appeared on examination of this part of the mine by the jury, who were mostly practical miners, and took a deep interest in the investigation, that the charge of powder had been excessive, and that the flame of the shot had either kindled some gas or had been powerful enough to distil from the coal-dust enough gas to cause a heavy explosion.

The investigation before the Coroner, Dr. Black, of Amherst, was of a searching character, and took in all the details of the management of the mine. The duties of the sulphur men, shot firers, brattice and shift men, their instructions, reports, etc., were fully considered. Evidence was taken as to the ventilation, dryness of the mine, etc. After full and mature deliberation the jury confirmed the public opinion of the mining fraternity, which had been, that at this mine all possible precautions had been taken for the safety of the men.

The verdict returned by the jury read as follows:—

"That the explosion was caused by the flame from a shot fired in No. 3 bord of No. 7 balance, igniting coal dust and a certain proportion of gas which may have been present at the time.

"They also believe that there was an unusual flame from said shot owing to a slip in the stone.

"They believe that the explosion was accidental, that no blame is attached to the management, and that they have taken every precaution for the safety of their workmen, and they make the following recommendations:

"*First.*—That in future, where safety lamps are used, and in very dusty places, powder should not be used.

"*Second.*—They recommend that in gaseous portions of the mine, before the men resume work after dinner, the places should be examined by competent officials.

"*Third.*—They recommend that the Local Government procure for the use of the Deputy Inspector of Mines a Shaw machine for detecting gas."

The above brief recommendations are of a practical nature, and if carried out would assist greatly in the preservation of life and property. Where there is gas enough to warrant the use of safety lamps, it is an anomaly to allow at intervals the discharge of an amount of powder equal in its heat and searching effects to many open lights; and in the same way when it is necessary to use safety lamps where both dust and gas are present, the use of powder is equally inexpedient. The abolition of powder brings up the still mooted question of what explosive can be trusted. The many ingenious expedients of lime cartridges, hydraulic wedges, compressed air, ratchet wedges, etc., have not been practically adopted by coal miners, and each new invention seems to create an equally new crop of objections; presumably the increased cost of the coal is at the bottom. Of the various explosives, roburite, a mixture of nitrated napthaline and nitrate of potash, seems to have found most favor. It has been used at the Intercolonial Colliery, Pictou County, and, it is stated, with satisfaction.

Should the recommendations of the jury prove agreeable to the Government, and a restriction be placed on the use of gunpowder in the coal mines of the Province, there is no doubt that the cost per ton of the coal will be increased, to an amount more than offsetting the inferior quality of the hand dug coal. As between the Pictou and Cumberland mines this would not cause much discrimination, but in Cape Breton, where some mines show gas, and others are reported as free from it, such legislation would be felt by some to be a serious matter. However, when regard is had to the immense tonnage of coal in Pictou County destroyed by fires, many of which can be traced to shot-firing, and to the many lives that have been lost, it may be conceded that the Province would be better off had no powder been used there for the past twenty-five years. If the mines be regarded, as they are in point of fact, the property of the people of Nova Scotia held in trust by the local Government, then the interests of our successors deserve consideration. Already in Pictou County there are large tracts of workings in which no powder is used and no open lights are allowed.

It seems incredible that with the advances made in safety lamps, electric lighting, electric and other coal cutting and wedging devices and improved explosives, that the time has not arrived when the use of so rude and dangerous an explosive as gunpowder can be dispensed with. With prophetic eye the miner of the future may be seen working in an atmosphere equally pure with that above ground, lighted by the brilliant rays of electric lamps, and readily and without toil extracting through the giant forces of electricity the treasures of the world below.

Turning from the horrors of this subterranean slaughter, it is pleasing to note the promptness and bravery of the comrades of the victims, who repeatedly risked their lives to rescue not only any possible survivors, but to restore promptly to sorrowing relatives and friends the remains of those who had been killed. This work was steadily carried on amid the foul air and the dangers of falling roof and stone in the exploded district, where every prop and support of the roof had been swept away. The efforts of the relief committee, and their appeals to public sympathy have been promptly answered, and there is every indication that a fund will be raised equal to the task of supporting the dependent relatives for some years to come.

It is also a matter of congratulation in the interest of the general public as well as of the company, that the explosion did not set fire to the mine, as too often happens. The destruction of the two fine mines that were the seat of the disaster, with their slopes, engines, bankheads, etc., would have crippled the company and the town of Springhill, and have proved a Provincial disaster. There were here at one time four slopes, on the three seams of coal being worked, and they were all connected. The management had isolated two of them and were about to isolate the rest. The wisdom of this course is apparent, as there is little doubt but that had these precautions not been taken a greater loss of life might have happened.

The value of the gold exported by the banks at Victoria during last year was:—

Bank of British Columbia	$203,111
Garesche, Green & Co.	183,587
Bank of British North America	25,331
	$412,029

EN PASSANT.

On another page of this issue will be found an account in detail of the third Annual Meeting and Dinner of the Gold Miners' Association of Nova Scotia, held at Halifax, on the 10th inst., at which the REVIEW was a participant. The occasion was one of unanimity and good fellowship, and was thoroughly enjoyable.

This Association has now rounded out three years of active, useful life; it has trebled its list of members, and has, in a quiet, unobtrusive, but effective way, accomplished a very creditable amount of good work for the gold mining industry of Nova Scotia. The need of such an organisation has been shown by its continued existence and increased prosperity, and the REVIEW wishes it many annual meetings of as happy a nature as the one just passed.

At the business meeting, held in the afternoon, some important amendments and additions to the existing Mines Act were fully debated in a most interesting manner, and it is opportune for the Quebec Government to note that they were chiefly in the direction of obtaining a more liberal as well as a more secure title. The deficiency of the Nova Scotia Act in this respect was well set forth in the paper "On Titles," read by Mr. B. C. Wilson, at the October meeting, which we reprint elsewhere.

Measures looking to the establishment of a permanent base line marked by stone or iron monuments in every gold district, and also providing for a barrier of unwrought country rock between lands owned by different and diverse owners, were also debated, and were committed to the Council to secure enactments of the same.

A pertinent query comes from a Cape Breton miner with regard to the cause of the Springhill explosion. He asks: "Why was the air not split to ventilate sections separately, and thence direct into return air-way? Does it not seem strange that the air having first passed over safety lamps should be returned over naked lights? What was there to prevent a fall of roof in any of the balances, forcing gas down on the main trolly-way, 1,900 foot level, or through on to No. 6 balance?"

Copies of the following resolution, passed at the last regular meeting of the Canadian Institute, Toronto, have been mailed to the mining men of the province:—

"The Geological and Mining Section of the Canadian Institute are of opinion that until a Provincial Department of Mines is established, the mining and metallurgical interests of Ontario cannot receive that attention which their importance demands, and therefore recommend that a Mining Convention be called to meet in the city of Toronto, at the Canadian Institute, on March 31, at 10 o'clock a.m., to consider measures for the advancement of the mining industry and the advisability of establishing a Provincial Department of Mines. The Institute is hereby requested to give notice calling upon the various mining localities throughout the province to send delegates to meet the delegates appointed by the Institute for the purpose of laying their views before the Provincial Government."

It is requested that representatives be sent to this convention, and the invitation is made general to all interested in mining in Ontario. We are heartily in accord with the object of the meeting, and trust that good will result.

We are very much pleased, and so will be all our Canadian readers, to learn of the election of Mr. John Birkenbine, M.E., of Philadelphia, as President of the American Institute of Mining Engineers. Mr. Birkenbine, who is well known in the Ottawa Valley for his papers on iron and its possibilities of manufacture at Ottawa, has at present charge of the iron ore statistics of the Eleventh Census. Mr. Birkenbine is alo the mainstay of that excellent periodical the Journal of the Charcoal Iron Workers of the United States.

The trouble at the Wellington, B.C., collieries has assumed a serious aspect; there have been what verged very closely upon riots, and it is feared that the conduct of the strikers may go from bad to worse. The original difficulty seems to have been almost lost sight of in the later issues, and affairs have reached a stage when any settlement has become exceedingly difficult. The situation is much to be regretted, not only on it own account, but also from the fact that an important coal producing centre has become in great part inoperative, and has lost ground that it will take long to recover.

Considerable prominence is given in some of our western papers to the reported sale to an Anglo-American Syndicate of the Badger, Porcupine and other well-known silver mines in the Port Arthur district. These properties having given substantial proof of their ability to produce in paying quantity are unquestionably of great value, but in view of the absolute silence maintained upon the subject by those interested, the report that $10,000,000 have been realised should be taken with a strong pinch of salt.

To all appearance the first Quarterly General Meeting of the General Mining Association of the Province of Quebec promises to be a notable one. Papers will be read by Dr. R. W. Ells, Ottawa; Rev. Abbé Laflamme, Quebec; Dr. J. T. Donald, Montreal; J. B. Smith, M.E., Glenalmond, and A. M. Evans, M.E., Black Lake. The subjects promising a lively discussion will be those by Messrs. Evans and Smith on "The Responsibilities of the Mine Manager," and "Mine Inspection," respectively. The Meeting will take place in the Windsor Hotel on Thursday 30th April, and in all likelihood will be celebrated with a dinner.

A new boring apparatus for mines has been brought out in England, which is especially designed for use in places where there is a possibility of breaking through into old workings or places in which gas or water may be pent up. With this invention the hole in the coal or other mineral is made gas and water tight from the insertion of the boring tool, and the pressure of either is indicated on a gauge attached. The tube proper is inserted in an outer casing which is placed in a hole two or three feet in depth, and secured to a timber frame as a fulcrum, at the outer end, and beyond has bolted to it a sleeve nut tapped to receive the screwed length of the feed screw of the boring bar, which is operated by manual or other power. At some convenient portion of the casing tube outside of the "face," a downward branch is provided, which is closed by a straight through valve, which, being opened, allows the debris from the boring tool to fall downward to the floor of the seam.

The patent cure-all man, the life insurance agent, and others of that ilk, have gained a well deserved reputation for unmitigated cheek and cool impudence, and their names will go down to posterity. But a new rival has appeared in the field who bids fair to rob them of some of their laurels. This formidable competitor is actively engaged in pushing an article known as "Shaw's Gas Testing Machine," and the calm impudence of his methods of business almost rise to the height of genius. The following is an extract from a letter written by him to the manager of a large Nova Scotian colliery: "Unless you do 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 the responsibility—I know the condition of your mines. Deliberate." In the face of such assurance we are speechless!

From the report of the annual meeting of Bell's Asbestos Company, reproduced in another column, it will be seen that although a large dividend, 15 per cent., was paid, yet it has decreased materially from the percentages paid in the last two or three years. The Canadian business is not responsible for this—that has been as productive as ever—but the English trade has fallen off very considerably, owing to the disclosures regarding the "gratuity system," which appears to have prejudiced the public against the company. How far this sentiment is justified is not for us to say; the modes of doing business vary greatly on different sides of the Atlantic, and what would be severely condemned in one country may be "winked at" in another; the unpardonable crime is to be found out. The financial position of the company is strong, however, and the present disfavor in which it is held should result in greater purity in the future, when it may regain the ground lost in the past year.

At the present time, when the Springhill disaster is fresh in our minds, the conclusions reached by the Prussian Firedamp Commission, elsewhere reproduced, are of especial interest. It may be remarked, however, that these experiments, while of undoubted value, did not show such uniformity of results under similar conditions as would warrant the drawing of anything more than inferences as to the explosiveness of coal dust. In some instances, with the same charge of dust, an explosion would follow in the one case and not in another, without any visible cause for the difference. Moreover, the conditions of an artificial test and an actual explosion in a mine are very different: in the one the atmosphere is charged with dust to a very appreciable extent, such as no miner would fire a shot in, and in the other, the dust is lying for the most part on the floor.

From returns received from the three principal railway lines we are enabled to publish the following estimate of the contracts for supplies, made for the ensuing year by our Nova Scotia collieries :—

GRAND TRUNK RAILWAY.

Colliery.	Quantity.
Gowrie	35,000
Springhill	65,000

CANADIAN PACIFIC RAILWAY.

Cape Breton	120,000
Pictou and Cumberland Co.	65,000

INTERCOLONIAL RAILWAY.

Springhill	100,000
Acadia	40,000
Phœnix	25,000
Intercolonial	20,000
International	3,000
Grace Bay	1,000
	474,000

The following letter from the Canadian Copper Company, under date of 16th instant, will be an eye-opener to our gullible friends in the West, who have pinned their faith on Mr. Ritchie's chimerical schemes and bombastic utterances :—"Mr. S. J. Ritchie, formerly an officer of the Canadian Copper Co., has ceased to have any connection with the company as a director, officer or stockholder, and he does not represent the Company in any capacity whatever. It has recently come to the knowledge of the Company that Mr. Ritchie has assumed a position of hostility to it, that he threatens it with malicious law suits and interference with its business. All persons having any business with the company will oblige us by paying no attention to any correspondence or interviews of Mr. Ritchie. The Company will, through its proper officers, attend to its affairs and the performance of all its contracts. By order of the president."

Apropos of the recommendation of the coroner's jury on the recent Springhill explosion, it may be well for our miners to consider the following objections to the Shaw Testing Machine :

(1). The machine does not register the presence of gas, even when in perfect order, except in the immediate vicinity of the mouth of the tube, and as the miners will be led to believe it is perfect in action, they will not exercise the usual care and prudence, and the result will be more accidents due to explosions of gas.

(2). The pipes will be continuously out of order, as it will be impossible to guard against the joints being forcibly broken, through falls of top and sides, squeezes, etc., and droppers of acidulated mine-water eating holes in them.

(3). In cases of outbursts of gas, one of the most dangerous forms in which it is encountered, the fire-damp will reach the miners' lamp as soon as it will the mouth of the tube, and if the miner is depending on the machine for safety he will be burned before any signal can possibly be given him.

(4). It is proposed to place a single tube in each working place. If there was any possible means of determining the proper location for the mouth of this tube it would not be required, as if it is known where gas will appear it can be watched and guarded against. The idea of the owners of the machine, is to place a tube at the highest point near the face of each working place. As these faces are swept with currents of fresh air which dilute and carry off the gas evolved there, it is more likely to accumulate in dangerous quantities in other parts of the workings. *Where those points are it is impossible to designate.*

(5). The principles of the machine are not new They have been proposed before on the continent of Europe, and after exhaustive inquiries into their merits, they have been discarded as worthless and dangerous.

The apparatus cannot be operated so as to give warning in all cases of the presence of fire damp in collieries where its appearance is only occasional. In mines where there is a continuous and general evolution of gas from all the workings it cannot be applied because it will require more pipes than can be put into the mine openings. The large number of pipes (if but a single pipe is run into each working place), will fill up the main air or ! lage ways, interfere with the ventilation, and prevent the working of the colliery.

The French Fire Damp Commission, whose report has recently been issued, condemns three similar appliances that were brought to its notice in the following terse language :—

"They are absolutely analogous to systems proposed for a long time to all commissions.

"A similar process was tried in Germany by Herr Hilt and abandoned as producing no effect as regards security.

"It would be useless since it is likely to sound every day in certain gaseous mines, or, again, not to sound, though the remainder of the mine is full of fire damp because there was none at the point where the apparatus was placed.

"An impracticable process in a mine with a continuous and general escape of gas and unrealizable in fact.

"This apparatus has the inconvenience of all warnings which may be found in places where they are of no use and are wanting in points where they are necessary."

The two Liberal candidates for the county of Pictou, N. S., in the recent contest expressed themselves something to this effect in addressing the coal-mining population of the district: "A large numbe of you are engaged in coal mining, Notwithstanding the contentions of partisans to the contrary there is not the slightest reason to doubt that the future of this great industry is largely dependent on our success in obtaining the markets of New England. Look at this fact. In the year 1853, when our coal was taxed by the United States, our sales then amounted to 120,754 tons. In 1854 it was admitted free, and that condition prevailed until 1866, at which time our sales reached the amount of 404,252, when it was again taxed. From that time forward, owing to the American tariff, the sales decreased. Let it be made free again and a far greater increase will take place commensurate with the largely increased consumption of coal by the New England States." The force of these arguments do not appear to have been appreciated by the electorate, for both were defeated by an over-whelming majority.

CORRESPONDENCE.

The Shaw Gas Testing Machines.

SIR,—In response to your enquiry respecting the Shaw machine for testing gases in coal mines and the suggestion, after the verdict at Springhill, that it would be well if the Deputy Inspector were supplied with one, I take pleasure in giving you the following notes :—

The Shaw machine *per se* and the Shaw system of signalling, etc., must not be confounded together, for the latter, however ingenious, is wholly impracticable. This has been time and again, shown up in the columns of the Scranton *Colliery Engineer*, but in spite of these exposures the company pushing the patent persist in ignoring corrections of the false inferences made in their interest and in confounding the encomiums which I believe are worthily bestowed on the machine, with endorsations on the Shaw system of signalling.

For the Shaw machine as a piece of philosophical apparatus for use in the laboratory, I am full of admiration. Within the limits of its application, it is wonderfully accurate, and for occasional use I should be glad to have access to one, or know that the Deputy Inspector had opportunities to make tests from time to time.

But applied as proposed, for the daily examination of mines generating gas constantly and freely, as do ours, it would fall far short of the requirements. We *know* that gas is exuding at every face and that it will catch and lodge in an advanced shearing or any little cavity back from the face, but we are not interested in knowing whether the percentage in any one of the pockets selected for the termination of the "system's" ¼" tube be 7, 7·5 or 8%. What we do want to know is approximately the *quantity* that will collect in any spot; the spots where, from time to time, as the circumstances change, it will collect, and the time taken for it to gather after being disturbed, and this information the safety lamp, in competent hands, gives us. The number of tubes, as, for instance, would require to make the tests now made, would be very great—so great that a special place would have to be kept and a gang of men would require to be constantly attending to the tubes and seeking fresh spots to which to take them. Not only at the working faces is gas given off, but from the freshly cut walls, from "backs" and "lypes" and "faults" left behind an exudation continues for a longer or shorter time. In the safety lamp we have a rough and ready portable instrument that finds the worst places and gives a crude gauge of the quantity given off. If we want more delicate tests of smaller percentages than the lamp shows, we have the Peiler lamps burning alcohol and Liveing's gas indicator, both portable instruments. The Shaw machine is not portable; gas to be tested by it must be brought to it either by bag or pipe. Pipes being fixed give no facilities for searching; the places where they might be most judiciously put, have to be found for them; on the other hand bags are cumbersome and allow of but few tests for each entrance of the "fireman," each bag representing but a single test, while with the lamp the fireman makes perhaps 100 or more tests on each round he makes.

The Scranton mining paper has enumerated many of the objections to the "system," and clearly shown its incapacity to give that safety against explosives claimed for it and the cruel heartlessness of its promoters in proclaiming to the bereft families of sufferers, that had Shaw's system only been in use, such or such an explosion had not taken place.

In a late number, the *Colliery Engineer* put down to ignorance many of the misleading statements made by the "system's" promoters, but my experience with one of the gentry left me no such charitable thought. Like a sow that is washed, etc., did he return to his advocacy of the efficiency of the system's ¼" pipes to draw off all the gas from a mine although shown a section of level 50 feet long, from walls and roof and floor gas escaped bubbling visibly to the eye and with a noise distinguishable to the ear. Tests too that showed 200 cubic feet of gas mixed with the air of one return, failed to get an acknowledgment from him that one ¼" pipe would not find and carry it all off. He was well trained!

I showed him that the Peiler lamp *did* recognize 1½% of gas; that the flame in a certain glass lamp did distinctly lengthen with a mixture the Shaw machine gave as of 2½% of gas, and yet so assertively perverted was this man's mind that he continued to repeat that the safety lamp would not show 2½% of gas—and his object in so saying was to make it appear that the safety lamp was totally inefficient and valueless for finding the presence of any less percentage of gas than 5 or 6%. Instead of the safety lamp being totally inefficient I will go so far as to say that in a gaseous mine where many tests have to be made and the option was given to use Shaw's machine alone or the safety lamp alone, the safety lamp would be given the preference by every competent practical man, and that no practical man ever made thoroughly familiar with Shaw's machine would trust to it alone to find out the true condition of his mine.

If, then, the Shaw machine is not suitable for the necessary daily examinations of a gaseous mine, you will ask, Wherein is it of value to the miner? I should say for testing places where gas is supposed not to be, where open lights are used; and for assisting in proportioning the several scales of air to the percentages of gas formed in different sections of the mine, it is accurate to the tenth of one per cent., while with Liveing's instrument and the Peiler lamp, allowances must be made for "personal error."

H. S. POOLE.

STELLARTON, N.S., March 14th, 1891.

The Ferro-Nickel Process.

SIR,—I read in your issue of December last, p. 183, a paragraph on nickel-steel. Your remarks regarding my claim of extracting the metal by a cheap process from the Sudbury ores, are true; and I hope to succeed as well as I did with the New Caledonia ore, which I discovered and afterwards treated metallurgically by my processes patented February 20, 1876, in France, and March 20, 1876, in England. In that patent occur these passages :—

"I therefore expressly reserve to myself the employment of carburet of iron, iron, cast iron, and steel, allied with a variable proportion of nickel, according to the circumstances. The nickel which I add increases the qualities of iron both in respect of its strength, malleability and capacity of resisting oxidation.

"To obtain alloys of iron and nickel it is sufficient (and I reserve this point), to combine the carburets of nickel and iron in proper proportions in the various actual operations of the transformation of carburets of iron into iron, cast iron and steel. . . . . I reserve the employment of what I call 'ferro-nickel' for the manufacture of gun-barrels, pieces of ordnance, knife blades, sabre blades, etc., and chains for naval purposes.

"It is clearly understood that in the various cases the proportions of nickel in the ferro-nickel will vary according as it may be desired to attain a higher or lower degree of tenacity, malleability and freedom from oxidation. By these alloys of nickel and iron I create, so to speak, a metal above or superior to the best "siderurgic products," a metal which attains the object so long sought for, of possessing at the same time a high degree of tenacity with great malleability, and but slight inclination to oxidation."—(Extracts from my English patents.)

Having been obliged by circumstances to transfer all my patents to the Nickel Society of Paris, I was unable to use them. The society made no use of them either, unless under the name of "Marbeau," my former associate in nickel business, who is a capitalist—neither chemist nor engineer. But my first patents have now expired, and having privately improved them in the interval, I hope now to enjoy the fruits of my sixteen years' labor.

JULES GARNIER.

PARIS, February 20, 1891.

Asbestos: Its History, Mode of Occurrence, and Uses.*

By R. W. Ells, LL.D., F.G.S.A.

To the casual observer it must almost seem like a practical application of the old saying about "Carrying coal to Newcastle," to attempt to give a lecture on asbestos, before the members of a society so thoroughly conversant with the features of this great industry as the members of the "Asbestos Club" are supposed to be. As, however, you have kindly invited me to deliver the opening lecture of the course which your association proposed to carry out, I will endeavor to place before you some facts pertaining to this mineral which may prove of interest, especially at the present time, when asbestos is assuming so prominent a place in the commercial and industrial world, more particularly as regards its origin, its distribution, composition and utility. But before doing so you must permit me to say a word or two in commendation of the enterprise which has led to the establishing of so important, and, it is to be hoped, influential a society as that which I have the honor to address on this occasion; an organization, which, I feel assured, if rightly conducted, will be a power for good in the land. So many new features are rapidly coming to the front in connection with the mining industries; so many improvements are constantly being made in methods of mining and in mining machinery by which hand labor is being rapidly superseded; so many changes in the mining laws and regulations of the several provinces are being carried out or contemplated, and so great are the changes in the mineral market, especially in the case of minerals so sparingly disseminated as asbestos, that a thoroughly organized body of men, intimately interested in all that pertains to the output, the economical handling, the shipment and ultimate disposal of this substance, is almost an absolute necessity. To a certain extent some of these points are doubtless intended to be met by the establishment of the newly organized General Mining Association of the Province of Quebec; but while that society should, from the influential position of many of its members, be able to do much good by calling attention to and correcting legislation which might be harmful to the mining interests of the province at large, and by the reading and publication of papers bearing upon special subjects connected therewith, there is, in a society such as you have so wisely inaugurated, in the very heart, probably, of the most important mining industry of this Province, much work equally as important to be done. Work of this kind, such as you should, I hold, look carefully after and take into your consideration, embraces not only the condition of the mines themselves, but the sanitary condition of your mining centres—often quite as important a branch of mining economy as the extraction of a certain number of tons of ore. Who, for instance, ten years ago, passing through this section of the country, one of the roughest, physically speaking, in the province, and, except from the mineral standpoint, of comparatively little value, would have thought that, in a very few years, such extensive mining villages would have sprung into existence. And yet you are only on the threshold of the industry. If the growth of your mining towns has been so rapid in ten years in the infancy of your development, what will it be in the next ten years, as your output increases, and when that output should have reached a five or ten-fold amount. Here then is where a club like this can make its power felt for good—viz.: in the establishment of strict sanitary regulations, in making due provision for the drainage, and for the moral welfare of the people under your influence and control; for if such provision is not made in time—and the sooner the better and easier—with the rapid growth of your town and the lack of a good water supply and proper facilities for the carrying off of the waste material for your population, you may certainly calculate upon the usual wretched experience of places which lack such sanitary appliances. Then there is the necessary protection against fire; in the construction of a complete fire system, the building of reservoirs for supply in case of sudden outburst, the obtaining of the necessary apparatus, and the placing of such fire fighting appliances under proper management. What do you suppose would be the fate of the Village of Thetford should a fire break out at one end of the place, with a strong wind blowing though the street, in the dry time of summer? How much of the town would escape destruction, and how many thousands of dollars' worth of valuable machinery would be destroyed? These questions may not seem, in the present state of this industry, of great moment to us, but they are, I hold, of the utmost importance, and this club of mining men is the one institution which can, by judiciously consulting on these subjects, and by working together harmoniously and systematically, do everything to avert possible disaster in the directions specified.

Then there is the social and mental improvement aspect of such a club, one of very great value in a place like this, where men of intelligence are thrown generally into surroundings not the most congenial, and when, unless some such society exists, which provides for an interchange of thought and comradeship, the tendency is to retrograde. And this isolation is one of the strong objections to life in a mining camp. In the present case, however, fortunately there is no necessity for such a state of things. In this district are a number of men well educated and imformed, not only in the matters more directly pertaining to the work in hand, but in the wider sense men who in the exercise of their profession of mining engineers and mine managers are familiar with many foreign countries and have a large store of the most valuable and important facts, connected not only with the profession of mining, but of great general interest as well. In such a club as this there should never be a lack of subjects for discussion, nor a meeting which should not be full of interest, for there is, as a rule, no body of men, professional or otherwise, in which one will find, or ought to find, at least, so great a spirit of good fellowship or *camaraderie*, and so spontaneous a feeling of give and take, as among our brethren of the mining profession. As for their hospitality, that of the true mining man is too well known to require further mention, as personally many of us can testify not only for the mining centres of Black Lake and Thetford, but in many other portions of the Dominion.

The Eastern Townships of Quebec have for nearly half a century been known for their mineral wealth in some form; but the country west of the St. Lawrence must be given the credit of having had in active operation the first great industrial works in this Dominion. I refer to the long established iron smelting forges of the Three Rivers district. Presumably the gold of the Chaudière River next came into notice, and was mined quite extensively forty years ago by the DeLery and other companies on the tributaries of that stream, while the copper mines which in connection with the asbestos form the principal sources of mineral wealth at the present day for this portion of the province, were first brought into notice about the same date, though the era of development did not take place till near the year 1860.

The principal sources of Quebec's mineral wealth, east of the St. Lawrence River, are in the slates and schists of the Cambrian, and pre-Cambrian systems, which extend across the province in a north-easterly direction, following approximately, and at a considerable distance inland, the course of that river. In connection with the slates and schists, an important area of eruptive rocks, diorites, granites and serpentines, the latter not an eruptive rock in itself personally, but an alteration from some of the varieties of eruptive rock. To the schists of the pre-Cambrian or oldest series belong, for the most part, the workable deposits of copper at the present day, though copper mines have been opened in many places in Eastern Quebec in the slate beds or dioritic masses of the Cambrian as well. These, however, with rare exceptions, notably the Acton and Huntingdon Mines, have not been productive of copper in paying quantity, but have served excellently for the expenditure of capital.

The slates and associated quartz veins of the Cambrian are apparently the source or storehouse of the gold in Eastern Quebec, and it is in the slates of this formation, on the Chaudière and the Ditton, that our richest deposits of the precious metal are known to occur, destined some day, I believe, when the conditions admit of their development, to astonish the Canadian people with their value.

In the rocks of the same system, the Cambrian, on the slate quarries of Melbourne, Cleveland and Shipton, and in the same formation also, are found most of the outcrops of serpentine which are here known so widely as the containing rock of that peculiar mineral asbestos, a mineral of comparatively recent introduction regarded from the commercial standpoint, but which in the last ten or twelve years has come into such marked prominence in certain branches of manufacture.

The asbestos mines of the province of Quebec are, at the present day, of special interest to the mining and industrial world, from the fact that in so far as now known they practically represent the only deposits where this mineral, of a quality adapted for spinning and for the finer purposes of manufacture, can be profitably obtained. So great are the advantages which these mines possess, particularly as regards their accessibility and the ease with which the asbestos is extracted, that unless fields as yet unknown and as easy of access can be discovered, this province will doubtless long enjoy the position of being the principal source of supply for this peculiar and important substance.

The rocks with which the asbestos veins are associated in Quebec constitute a somewhat distinct series, which have, for the last thirty years, been known under the name of the "Quebec group." They comprise an extensive and important development of both sedimentary and eruptive rocks, which extend throughout the eastern part of the province, from the Vermont boundary to the extremity of Gaspé peninsula. They are not recognized in their entirety in any other part of Canada, though certain portions of the group are found in their extension southward into the United States. Crossing the Gulf of St. Lawrence they, however, form a very extensive belt in the island of Newfoundland, where, more particularly at certain points on the west coast, the same series of slates, sandstones, diorites and serpentines occur, the whole presenting features both from geological and mineralogical standpoints, very similar to what are seen in this portion of Canada. While these rocks in Newfoundland have, to a certain extent, been traced out, in so far at least as the entirely unsettled and unopened character of that section of the country permitted, no systematic search for asbestos has as yet been made, though that the mineral occurs there at a number of points and in a variety of forms is clearly indicated by the specimens which have from time to time been obtained in the course of the general geological exploration of the Island. Some of these specimens belong to the group of actinolitic minerals like the deposits found in Potton and Bolton, but among others observed from that country were samples of vein asbestos, equalling in quality any obtained at Thetford, and having a fibre from two to three inches in length. Little attention has, however, been paid to these deposits by the people of the island, and their extent is entirely, as yet, unknown. It cannot, however, be expected that this seeming indifference will long continue, in view of the rapidly increasing demand and consequent advance in prices. And it is probable that the time is not far distant when Quebec's greatest rival as a source of supply for asbestos will here be found.

While the mode of occurrence of asbestos, and, to a limited extent, its uses as well, have been known to a few, probably for the past twenty centuries, the discovery of its true economic value and of its great commercial importance are matters of quite recent date. Under the general term "asbestos," we find included several varieties of minerals, or of rock matter, some of which present startling and somewhat anomalous features. For instance, rocks as a rule, or the ingredients of mineral veins are generally regarded as possessing a weight or density several times greater than water, yet in one form, at least, of this mineral, we have a substance so light that it will float readily upon water, and has in consequence received the name of *mountain cork*. To most people, also, in speaking of rocks, minerals, or ores generally, the impression is conveyed that these are dense, heavy bodies, which can be crushed to powder with the proper application of sufficient force, yet here we have a mineral which can be pulled apart with comparative ease, teased out into fibre, and which thereupon presents the characteristic appearance of fine floss silk or cotton, so much so that in certain places this material is familiarly known by the name of cotton rock—or as the French call it, *pierre du coton*.

We have therefore here a substance which in some respects presents features belonging to both the mineral and vegetable kingdoms.

While, however, asbestos in all its forms must be styled a true mineral it possesses certain properties which distinguish it very clearly from many others. Among these presumably the most important is that of non-conductivity or its power of resisting the action of heat, in which respect it possesses some of the properties of wood, which also is in one sense a slow conductor, though in much greater perfection; since wood under the action of sufficient friction rapidly becomes charred and even ignited, whereas friction apparently exercises very little influence upon asbestos, no matter how long it may be applied. This property of non-conductivity, or of resistance to fire or heat, is one of the principal reasons for its extensive application in certain lines at the present day.

The term *asbestos* is derived from the Greek and signifies literally *inextinguishable*, while the other term frequently applied to the same mineral, viz., *amianthus*, is also of Greek origin and signifies *undefiled*, from the property possessed by the mineral of being purified by the application of flame without injury to the substance itself. This was a property well recognized by the ancients since we read in several of the earliest authors that the custom prevailed of wrapping the dead bodies of their important personages in an incombustible cloth by which the ashes resulting from their cremation were retained intact. The process of weaving this cloth from the fibres of amianthus shows that considerable scientific skill in the textile arts had been acquired by those people, judging from the difficulty which has been experienced even in modern applications of the art, and it is supposed that the requisite degree of tenacity was imparted by the admixture of threads of flax or silk, which could afterwards, if necessary, be removed by burning. The wicks of the lamps in the early heathen temples, which were supposed never to be extinguished, were also held to have been made of this material.

The resistant action of the asbestos fibre, or of the cloth woven from this fibre, to heat, is one of its most wonderful properties. Temperatures of 2000° to 3000° are easily withstood, while with some varieties a temperature of 5000° Fahr. has apparently produced no visible effect. Its property also of successfully resisting the action of acids is one of great value, and these properties render this substance of great importance in certain chemical operations, so much so that its use in this direction is rapidly increasing.

In addition to the cloth used by the ancients in the process of cremation, napkins were also woven and specimens of these are preserved in the museums of several of the cities in Italy. The old story of the table cloth of Charlemagne is doubtless familiar to many of you, in which it is stated that he used to draw this cloth from the table, all soiled with the *debris* of his feasts, and in the presence of his guests, throw it upon the blazing fire, from which it was soon taken, cleansed from all impurity. This peculiarity, however, probably applies to a cloth made from the true asbestos and not from the chrysotile, the difference in which will be pointed out as we proceed, but which varies from the other somewhat in composition. To the former variety, also, probably belongs the garment described in the story so quaintly given in the book by Montpetit, concerning the French *habitant*, in which he relates that at a certain lumber camp in one of our great northern forests, one of the men, newly engaged, upon his return from his day's work in the soft melting snow, when the rest of the crew were gathered about the stove, coolly proceeded to remove his boots, and then his socks which he dashed into the open fire. He, however, speedily extricated his foot gear, now cleansed to immaculate whiteness, and proceeded to dress his feet as if nothing unusual had occurred, a proceeding which, it is needless to say, among a group of people unaccustomed to witness such marvels, resulted in something stronger even than amazement, and with a sudden accession of terror at the presence of a man who could thus perform such miracles with apparently flaming garments, they in-

* Delivered before the "Asbestos Club," Black Lake, P.Q., Feb., 19th, 1891.

continently fled and left the uncanny stranger undisputed master of the situation, under the impression that he could be no other than the evil one himself. Explanation was of no avail, and the men refused to return to work until the foreman had discharged absolutely the unfortunate wearer of asbestos socks.

Somewhat analogous to this is the story related to me by one of the local managers of an asbestos mine in Coleraine township. This gentleman, also, was the fortunate possessor of a pair of asbestos mittens and under the impression that these were indestructible by fire, and desirous of astonishing the crowd which was gathered around the stove in a country store proceeded to throw one of them into the flames within. The success of the wished for miracle was not, however, equal to his expectation, since upon withdrawing his mitten from the flames, after a short interval, it was found that the action of the fire had rendered the fibre so brittle that its tenacity was almost entirely destroyed, and the mitten was of no further use. In order to explain, then, the seeming inconsistency between the two cases, it may be stated that what is known as the Quebec asbestos of commerce and the true asbestos, are two distinct substances, and belong to two distinct groups of minerals. Thus asbestos proper belongs to what is known as the pyroxene or hornblende group, while that obtained from the Quebec mines belongs to the talc or serpentine group. The former is classed among the igneous rocks proper, such as syenites, granites, porphyries, etc., and embraces, among other varieties, augite, diallage, hornblende, etc. Some asbestiform minerals are augitic, but the greater number belong to the hornblende family, and are known by several names, such as amianthus, asbestos, byssolite, tremolite, actinolite. In the variety known as pilolite, which is also a division of the hornblende group, several curious forms of asbestos occur, such as mountain paper and mountain leather, in which the fibres have become felted together in a somewhat uniform consistency, and are in the form of thin sheets; mountain or rock cork, which is a more massive form, and in which the specific gravity ranges from .68 to 1.34, and mountain wood, the name of which is derivable from its lignıform or woody aspect. The chemical composition of these several asbestiform minerals varies considerably, but for the most part they may be classed as silicates of alumina and magnesia, with varying proportions of lime and iron and occasionally a little water. The varieties known as mountain cork and leather contain a considerable proportion of water, amounting sometimes to 23 per cent.

A peculiar bluish variety known as crocidolite, and found in South Africa, Norway, and at several other points, contains a very considerable proportion of iron protoxide, sometimes as much as 35 per cent., in addition to silica, magnesia, and soda, and contains also a small percentage of water. This mineral is more properly a silicate of iron, and has great tensile strength as compared with the ordinary form of asbestos, though deficient in fire-resisting properties.

These minerals occur for the most part in serpentinous rocks in the oldest formations. In Canada, the variety known as actinolite occurs in large masses in the Laurentian rocks of Ontario, in the townships of Elzevir, Lake and Tweed.

It is also found in Norway and Sweden where rocks similar in age and character occur. The finer varieties of amianthus and asbestos occur most abundantly in the Alps of Savoy, near the boundary of Switzerland and Italy, and in the island of Corsica, at which places beautifully white silky fibre is found in considerable quantity along with much of the coarser varieties.

The variety known as tremolite is found in several countries, generally in the old Laurentian rocks, in connection with limestone. It consists of long prismatic crystals of white, grey and green colors, but has not the fine fibrous texture of amianthus or chrysolite, and it frequently graduates into actinolitic forms. It occurs in the Laurentians of Canada and New York where it has been mined for some years to a limited extent. Cork, leather, etc., are also found in rocks of the same horizon, and beautiful specimens of the former are obtained from the township of Buckingham, in Quebec. The preceding minerals belong to what is styled the group of the anhydrous silicates in which water is supposed, for the most part, to be wanting.

Of the other varieties, belonging to the talc and serpentine group we find water entering into their composition to a very appreciable extent, and they are therefore placed in the group of the hydrous silicates of magnesia. These include talc, soapstone, or stearite, potstone serpentine and a number of other kinds, somewhat similar but not economically important. The composition of all these may be generally stated to be silica, magnesia and water, with occasionally a little alumina and iron, the percentage of water, ranging from 2½ to 5, in talc, to 12½ and 15 in serpentine, so that the distinction between the two groups, the hydrous and the anhydrous, is, in this way, clearly marked. While the composition of talc, soapstone and serpentine is to a great extent the same, or with the ingredients in slightly varying proportions, the mineral which we call asbestos in Quebec, but whose true name is chrysolite, is confined almost entirely to the latter. The serpentine itself is frequently of varying colors, being green, grey, red, yellow and brown, having a hardness of about 3 to 3½, and a specific gravity of 2.5 to 2.7. It is generally massive, but sometimes presents a banded structure and is occasionally quite slaty, being frequently marked with spots, veinings and stripes of various colors. The coarser fibrous varieties are known as picrolite and baltimorite; the fibres themselves being devoid of the soft silky character and lustre which is a peculiarity of the better kinds of the variety known as chrysolite or the asbestos of commerce.

Asbestos is therefore seen to present a great variety of forms, and in some one or more of these it is found at various places over the greater part of the surface of the globe. Among these may be mentioned in Europe, small deposits in England, Scotland and Ireland; in France to a limited extent, except in the extreme southeast in Savoy, more abundantly in Italy and Portugal, and on the island of Corsica, where the beautifully silky variety, amianthus, is quite abundant. In Germany, Bavaria, the Pyrenees, Russia, Norway and Sweden deposits of greater or less extent have been found.

In south Africa the peculiar bluish variety, crocidolite, has already been referred to, and recent reports state that extensive deposits of asbestos occur in the serpentine belts of Kimberley, in which the diamond diggings also are situated. Asbestos has also been found in South America, in Brazil, in Australia, and in Asia Minor. In several parts of Newfoundland, excellent fibre, more particularly of the variety known as chrysotile, is known to occur, and in the United States it is also found in connection with the serpentinous rock of the eastern mountain range in nearly every State from Maine to Georgia. On the west coast also it is reported in considerable quantity from California and British Columbia, and as far north as Alaska, while its presence in the rocks of Ontario and Quebec has been recognized for many years. With such a widely extended distribution, therefore, it would seem natural that the supply of the material should be practically unlimited. Such, however, does not appear to be the case; since in many of these places the quantity is so small as not to be available for general use, and in others the quality is such as to be economically valuable only for the inferior purposes of manufacture; while in others again the difficulties of access preclude all possibility of successful mining, for years to come at least. Prior to 1880, the greater part of the fine fibre adapted for spinning came from the mines of Italy and Corsica, and owing to the difficulty with which it was obtained and its exceptionally fine quality commanded a very high price in the market, reaching as much as $250 to $300 per ton; but the discovery of the chrysotile deposits in the Province of Quebec, of a quality equally well adapted for spinning as that of Italy, taken in connection with the fact that these were situated directly along a line of railway within short haulage of a shipping port, almost revolutionized the industry, and has lately nearly closed the Italian mines.

Much of the so-called asbestos of these mines, however, is not adapted for spinning, and is used for the manufacture of mill-board, cements, paints, etc., as is also the output from such mines in the United States as have been working more or less constantly for the last twenty years. The output of the Quebec mines has even already had such an effect upon these that their present output is probably scarcely one-tenth of what it reached ten years ago.

In Ontario, also, a large quantity of the variety known as actinolite is mined and ground at Bridgewater in Hastings County. This is used for cement roofing, being mixed for that purpose with tar, the fibrous texture of the material being sufficient to allow of its felting sufficiently, but not for spinning.

The non-conducting substances available in the process of manufacture in addition to asbestos are not numerous. Among the most important, probably, may be mentioned *infusorial earth*, which is generally found as a white or a grayish white earthy material occupying the beds of certain lakes, or under peat bogs, and in deposits frequently of very large extent. In composition this earth is almost a pure silica, and is composed of the siliceous shells or crusts of diatomaceous plants, spicules of sponges, etc. It is also known as tripolite, and under the name of *Tripoli*, or polishing powder, is familiar to most housekeepers. The localities where infusorial earth occurs most abundantly in the States are in Virginia, where an immense bed, many feet thick, underlies the city of Richmond; and in California, where a deposit of fifty feet in depth occurs near Monterey. In Germany large deposits also are known under the name *kieselguhr*, and much of this material used in the United States comes from that country. Numerous lake bottoms filled with this substance occur in the provinces of Nova Scotia and New Brunswick, generally of much greater purity than the American or German earth, and it is also found to some extent in the Province of Quebec.

It is extensively used for the manufacture of water glass or soluble silica, and for the coverings of boilers and steam pipes, for which purposes, owing to its great non-conductive properties, it is especially adapted. As a polishing powder it is also extensively employed, and for some years was an ingredient in the manufacture of dynamite, as an absorbent of the nitro-glycerine which enters into the manufacture of this explosive. For this purpose, however, wood-pulp has now to a large extent superseded it. In the lining of safes and for the protection of exposed portions of buildings, it is also largely used, but it can never compete with the asbestos fibre in the peculiar processes to which that product is now applied.

Another non-conducting material which enters largely into competition, both with asbestos and infusorial earth, is the substance known as *mineral wool*. This is an entirely artificial preparation, and its discovery was doubtless due to the fact that a somewhat similar substance occurs in a state of nature in connection with certain volcanic eruptions, more especially in those of the Sandwich Islands, where the slaggy volcanic liquefied matter is acted upon by blasts of air and blown out into long silky fibres, which have received the name of "Pele's Hair."

Mineral wool, or slag wool, is formed artificially in a somewhat similar way, viz., by subjecting a stream of molten slag from a blast furnace to a jet of steam or compressed air, by which means the slag is broken up into minute particles, generally with a small fibrous end or tail, which accumulate as they fall and resemble masses of roughly teased out cotton. The solid particles which form the head of each minute atom are subsequently detached, and the finer fibres carried over into a separate chamber, when they are ready for use. This material possesses wonderful properties as a non-conductor of heat or sound, has great lightness, and is absolutely fireproof. It is extensively employed as a material for covering boilers, steam-pipes, and for lining buildings to render them fire, sound and vermin proof. While, therefore, it competes very successfully in many points with asbestos as a non conducting substance, like infusorial earth it has not the property of being spun, and has also several objectionable features besides which interfere somewhat seriously with its universal application.

Steatite or soapstone is an excellent resistant of heat, and as an ingredient in fireproof paint is probably quite as valuable as asbestos, while as linings for stoves, furnaces, etc., it has long enjoyed a well deserved reputation. It also enters into competition with asbestos as a loader or filler of paper stock, and for several other purposes to which the lowest grades of the asbestos waste were formerly applied, but its special use at the present day would appear to be the manufacture of a non-corrosive and fireproof paint.

As non-conductors of heat and sound several other preparations have been invented, among which may be mentioned *wood-pulp* and *terra-cotta lumber*, the latter being principally a mixture of clay and sawdust, made into bricks like ordinary clay. This mixture possesses great lightness, especially fitting it for interior work, such as dividing walls in buildings, being both fire and sound proof, but can scarcely be said to be a rival or competitor of asbestos in many respects.

Having thus briefly reviewed the several asbestiform and other non-conducting substances, we can now proceed to the consideration of the asbestos or chrysotile deposits as they occur in Canada, and more particularly in the Province of Quebec, since it is in this province that the most important developments in this mineral have taken place.

The workable asbestos of Quebec is, in so far as at present known, confined to the serpentine areas of the mountainous belt which extends through the Eastern Townships from the boundary of Vermont to the extremity of Gaspé peninsula, with the exception of certain peculiar deposits which are found in connection with the serpentinous limestones of Templeton and the Gatineau valley in the Laurentian rocks north of the Ottawa. Concerning these latter deposits sufficient development work has not yet been done to determine definitely their economic value, but the quality of fibre obtained from some of the asbestos veins of this district is remarkable for its purity or freedom from foreign substances. The serpentines of the Townships form a series of disconnected masses, generally of small extent, surrounded by igneous rock, principally dioritic, but occasionally rising through great outcrops of slates or schists. At times these serpentinous masses assume such proportions as to rank almost as mountain ridges, as can be seen in Wolfestown and Coleraine, and in Gaspe in certain parts of the Shickshock range. As pointed out last year in an excellent paper "On the Serpentines of Canada," contributed by Mr. N. J. Giroux, of the Geological Survey, to the Ottawa Field Naturalists' Club, these peculiar rocks are found in formations of different ages from the Laurentian to the Tertiary. To the latter period some of those found in British Columbia are supposed by Dr. G. M. Dawson to belong, while others are there associated with rocks of Carboniferous age. It is evident, therefore, that they have a very wide geological range; and this is seen, also in the province of Quebec, where the serpentinous limestones north of the Ottawa are of Laurentian age, while the serpentine east of the St. Lawrence is associated with rocks of Huronian, Cambrian, and possibly even newer systems. Whether this difference in the age of the serpentine formations may have any influence on the question as to the presence or otherwise of asbestos in workable quantity is a question not yet fully ascertained, but there is some reason to suppose that the serpentines of a certain age are more productive of chrysotile in paying quantity than that of more recent date in this country, in the same way that the quartz veins of the Cambrian rocks appear to be the seat of more productive gold mines than those found in newer formations.

The serpentinous rocks of New Brunswick have not as yet yielded asbestos except as mere thread-like veinings. These are found to belong to the Laurentian system. In Nova Scotia it has not yet been recognized, but recent investigations in northern Ontario, according to the report of the Royal Mining Commission for that Province, lately published, indicate the presence of fibrous asbestos in the vicinity of Lake Temogami, according to the statement of Mr. E. Haycock, in veins of considerable length. This is in rock also supposed to be of Huronian age.

The serpentine areas of the Eastern Townships may be divided into three portions, viz.: 1st, a southern, embracing the masses in Potton, Sutton, Bolton, Orford, Melbourne and Shipton, which terminates not far from the Shipton Pinnacle, south of the village of Danville, though occasional detached outcrops appear above the surface for a few miles further north; 2nd, a central portion beginning with Big Ham mountain and extending through the townships of Ham, Coleraine, Thetford, &c., to and

beyond the Chaudière River, in which the most conspicuous and important masses are in Thetford and Coleraine; and 3rd, an eastern area which is found in the Shickshock range of Gaspé and of which the most eastern outcrop is in Mount Serpentine, on the Dartmouth River, about ten miles from Gaspe Basin.

While all serpentine rocks present certain leading features which enable them to be readily recognized by anyone familiar with their general aspect, there are in the serpentine of these three areas several marked peculiarities which serve to distinguish them quite easily. Thus the rocks of the southern area are frequently, though not always, slaty, and occur sometimes with much soapstone, or potstone, and sometimes with dolomite, and have frequently a greasy smooth aspect on the slaty surface. About Brompton Lake they are associated with great hills of dioritic rock as well as with slate, and contain masses of white garnet. Mining has been attempted at several places in these rocks, more particularly for ores of copper, which has produced some very fine hand samples, but in so far as yet worked, not in quantity to be remunerative. Veins of asbestos are seen occasionally, but these are as a rule of short fibre, either soft and pasty, or harsh and stiff, while in extent they are mostly short and gashy, and do not possess the well defined vein character of those seen in Thetford and vicinity. Near Danville, however, in a peculiar knoll-like mound of serpentine the veins of asbestos are well developed, and fibre of very fine quality and of suitable length for spinning is found in abundance. The occurrence of this mass of serpentine, rich in asbestos, in a belt which is well developed a short distance to the south, but which is there, in so far as yet prospected, almost deficient in asbestos fibre of any length, is peculiar, and serves to indicate that, even in most unlikely places, exceptional development of conditions may give place to a favorable change in the rock which may lead to the establishment of a profitable mining area.

In so far, however, as experience has determined the conditions for profitable mining, the serpentine of this southern area does not yield indications favorable to successful development; and the same remark will apparently apply to much of the serpentine found in the adjoining State of Vermont. It is possible that much of this serpentine may be the result of alteration from dolomitic rock, or from slates which contain dolomite; whereas it is clear that much of that found in Thetford and Coleraine is an alterative product of dioritic eruptive rock, rich in olivine or some allied mineral.

The rocks of the central or Coleraine area differ as a whole from those just described in being, as a rule, much more massive, and occurring in large areas. They have associated with them deposits of chromic iron and of magnetite, as well as of asbestos. Large areas of steatite or soapstone occur also about Ham Lake, and mining for nickel was carried on in this vicinity many years ago, the quantity of this mineral obtained being, however, but small. The country occupied by these rocks is generally rough and unpromising from the agricultural standpoint, and the whole area from Ham Mountain to the northern terminus of the main belt in Thetford or at the Bull Mountain in Adstock is of this description. In character of rock the serpentine presents several varieties. Portions are hard, reddish brown weathering and very siliceous, as seen in much of that in the townships of Wolfestown and Ireland, and even in the Coleraine ridge south of Black Lake and about Lakes Caribou and Little St. Francis. In this hard siliceous serpentine, asbestos very rarely occurs, and when present is mostly of imperfectly developed fibre in short and gashy veins. Occasionally, however, seamy partings are found which at first glance and at a distance, present somewhat the aspect of asbestos veins, but on closer examination reveal the existence possibly of a small parting of fibre, or sometimes only of a seam of serpentine. In certain portions of the belt these seamy partings are quite numerous, and by some prospectors are supposed to indicate the presence of workable veins, on the general principle held by many practical miners, that a vein of mineral matter always becomes larger as it is followed downward, a principle of such peculiar application that its absurdity should be apparent to anyone who has ever thought a moment on the subject.

Passing beyond or to the north-east of the great masses of serpentine in Thetford and Coleraine, detached masses, knolls, and sometimes bands of this rock crop out at intervals. These are well seen near the Chaudière River, both in the Bras de Sud-Ouest and in the Des Plants streams; but though these outcrops have been carefully prospected, nothing more than small gash veins have been found. Further to the north-east on the south side of the great dioritic mass called Moose Mountain in Cranbourne, a small outcrop of serpentine, on the bank of the Etchemin River, shows small veins of one quarter to possibly half an inch of fibre, and this is the most northerly outcrop of asbestos-bearing serpentine yet known in this belt.

The most easterly area, viz., that of the Shickshocks, is largely made up of serpentine, different in character from the rock of Thetford, which we may take as our typical locality; the southwestern portion being very hard and siliceous, in contact with black hornblende schists on the north; while the eastern or Mount Albert serpentine, which is the principal area in this direction, is frequently banded with shades of reddish brown and green. In these rocks only small veins of imperfect fibre have yet been found, and the generally hard and siliceous character of much of the rock is against the presence of large deposits of the fibrous variety. In the most easterly exposure, on the Dartmouth, the serpentine is very much of the same nature as in the Shickshocks, associated with hornblende schists and containing small veins of one-quarter inch fibre of but little economic value.

It is easily seen, therefore, that the character of serpentine which is really asbestos-bearing to an extent which can be profitably worked, is confined to a comparatively limited area, and more particularly to certain portions of the townships of Thetford, Ireland, Coleraine and Wolfestown, in which localities successful mining operations have been carried on for some years. But even in these favored districts there are large portions of the serpentine belts which, in so far as yet proved, have disclosed no asbestos in quantity to be economically available. The rock carrying the merchantable asbestos is generally a greyish weathering serpentine of some shade of green on fresh fracture, generally a greyish green, in which are contained numerous small particles of iron both magnetic and chromic, more generally the former. Serpentines that have a black, hard, chippy aspect do not apparently promise well, nor does the rock which weathers a dirty reddish brown. In the asbestos-bearing rock proper the veins of asbestos are seen, without any special arrangement, intersecting the mass of the rock generally in every direction, but for the most part at a considerable angle both to the perpendicular and horizontal. Certain peculiar arrangements of these veins are, however, noted in certain areas, as at the King Bros.' mine in Ireland, where the serpentine appears to be regularly stratified almost in the manner of sandstone or quartzite in layers dipping to the northwest, and the veins of asbestos apparently follow what, in sedimentary rocks, would be regarded as the bedding planes. In several other places the veins, few in number, cut the rock in an almost horizontal position, and when found in a knoll can be traced across from one side of the hill to the other nearly on the same plane, but as a rule the veins are irregularly placed. In size they range from mere threads up to a thickness of five or six inches, though the most of the workable veins in the principal mines do not, or but rarely, exceed two and a half inches in width or length of fibre, and such veins, where the asbestos is of good quality and unbroken by partings of iron, are regarded as extra No. 1 material. There are, however, generally, more small veins of one inch or less than of the larger size. Serpentines associated with talc or with soapstone, where the latter is in quantity, rarely appear to carry veins of asbestos to any extent, and such steatitic rock is not usually considered good mining ground. The Broughton mine may possibly be cited as an exception to this principle, since at this place a vein of large size of very fine fibre was found lying between serpentine and soapstone walls. As the soapstone became more abundant, however, the size of the vein rapidly became less and finally split up into small strings and became useless, and it is a fact worthy of note that at the great and profitable mines in Thetford and at Black Lake soapstone is absent from the rock mass.

As for the origin of these veins in the serpentine several theories have been advanced. In composition the vein matter is, as already mentioned, apparently the same as the containing rock, and the chrysotile is simply a fibrous serpentine. Some have supposed the veins to be formed when the mass of the rock was in a pasty state and exposed to sundry strains or twistings which produced the fibrous nature of certain portions. That the rocks have been exposed to such violent action is very evident from their present faulted character. Others have supposed the cracks to have been formed by the cooling and shrinking of the mass from a heated and pasty state by which cracks have been formed, which subsequently became filled with asbestiform matter from below. In whatever way the fissures were caused, and it is very probable that they have been formed by the great processes of metamorphism to which the rocks were exposed in the change from dioritic matter to serpentine, the vein asbestos appears more naturally to have been produced by a process of segregation of serpentinous matter from the sides of the fissure, very much as ordinary quartz in many mineral veins is known to have been produced, the segregated or infiltrated matter gradually filling the original fissure, and meeting at or near the centre, in proof of which the presence of a comb of particles of iron is very often found occupying the centre of the vein, and quite frequently these iron grains assume sufficient size as to form a regular parting of iron ore in the fibre. In this respect asbestos veins resemble very closely mineral veins with quartz or calcite which frequently contain alternate layers of ore on either side of a central comb of crystals. The arrangement also of the fibre at right angles to the sides of the containing fissure, except where the rock has been disturbed, is confirmatory evidence in the same direction.

In some of the mines fibre of exceptional length is observed. Sometimes there are veins caught along lines of fracture and drawn out of their natural position. At other times this long fibre is, to some extent at least, due to the friction of the rock walls by the displacement of a fault. In this way the long woody fibred material, known as hornblende to the miners, but which is rather a form of picrolite, is probably produced. In the same position also, and due probably to the same cause, are the long well fibred strips of asbestos seen in some of the mines, and which at first sight might almost be taken for vein matter of exceptional length. A very peculiar form of asbestos is found on an island in Lake Nicolet, where also the coarse picrolitic variety is well seen, which consists of small concretionary pellets of asbestos containing a nucleus of serpentine and enclosed in a steatitic rock. This peculiar development was first pointed out by Mr C. W. Willmott, and has not been recognized at any of the other mines, at least to a noticeable extent. But a still more peculiar form is that seen at the Megantic mine in Coleraine, where the serpentine wall for the distance of several feet is laced with minute veins of not more than a twentieth of an inch in thickness, and presents the appearance, on fresh surfaces, of a rock regularly and evenly striped with greyish white paint. The same mode of occurrence of small veins is seen at King Bros.' mine in Ireland, and at Bellmina, and occasionally some of these smaller veins there come together and form one of workable size. This peculiarity is also conspicuous in the serpentine asbestos deposits of Templeton and the Gatineau district, although the character and age of the containing rocks are entirely distinct from those of the eastern area. In this latter place the small veins of asbestos have a thickness generally of an eighth to a fourth of an inch, with partings of light greyish serpentine of about the same thickness. These occur throughout a space sometimes of a foot or even possibly more, and enclose roughly lenticular masses of limestone, which are often of large size. Sometimes several of these detached veins coalesce and produce a large vein having a thickness of two inches of wonderfully clear fibre, which continues for a short distance and then splits up again. The same peculiarity is seen in the lower part of the large vein at the Broughton mine in eastern Quebec, where the hanging wall is soapstone.

While, therefore, indications of asbestos or chrysotile may be found at most places where serpentine rocks occur, it is, I think, very clearly established by the work of prospectors, as well as by that of the staff of the Geological Survey, that very many areas do not contain, nor are likely ever to produce, asbestos in workable quantities; and while the greatly enhanced price of the mineral renders operative, areas which a few years ago could only be worked at a loss, it must be borne in mind that the great profit is made in the output of first-class material, rather than in third-rate asbestos. To any person, therefore, contemplating investment in such mining areas, it is plain that the first thing to be attended to is a careful examination of the property by one not personally interested in the matter, and one, further, who has a good knowledge of the different kinds of serpentine, as well as of the conditions which should govern the occurrence of asbestos in sufficient quantity to repay the money invested. Unfortunately prospectors as a class, not only of asbestos properties, but of other minerals as well, are not sufficiently well informed as to such conditions. Many are led by what they have observed in connection with mines in certain other areas, such as for instance in the case of the Cornish miner, who measures everything in a Cornish half bushel. Whereas the truth is that the profitable or economical development of minerals very frequently depends upon the presence of local phenomena or conditions which have affected certain limited areas only of the earth's surface or crust. Just what the conditions have been in the past by which the serpentine areas of Thetford and Black Lake have become so impregnated with asbestos veins of great purity and large size, while the areas a short distance to the east or west should be almost devoid of asbestiform mineral, cannot yet be conclusively settled. It is possible that the presence of the large intrusive masses of granulite, which are of more recent date than the serpentine, may have had some effect in this direction, but in that case we should expect to find at Black Lake, where these granitic masses are the most abundant, the richest deposits of asbestos. On the contrary, however, it is found that the largest and most important veins are found at Thetford, where the granitic masses are comparatively small and generally confined to narrow dykes; for while the serpentine of this area is, according to the best testimony on the subject, due to an alteration of igneous or dioritic rocks, we can scarcely suppose that the asbestos itself is of igneous origin. While, therefore, the reason why the Thetford areas are the most productive of fine asbestos fibre has not yet been satisfactorily ascertained, we have been able to learn some facts from the study of these Thetford mines, which are of value to guide the prospector or the scientific explorer in the search for other deposits.

Since the asbestos veins occur throughout the mass of the rock and come directly to the surface where exposed, as in the hill at Thetford mines and the great escarpment to the south east of Black Lake station, the mining of the mineral does not follow the methods which are usually employed in the working of other mines, viz., by underground slopes and levels connected with the surface by shafts, but is simply open quarry work, the entire rock being removed, broken up, and the veins of asbestos separated by hand cobbing, in so far as the size of the veins will warrant the expenditure of labor for this purpose. The bulk of the barren serpentine necessary to be removed in order to obtain a ton of fibre is consequently very great, and while no exact data are to hand by which the relative proportion of asbestos and serpentine can be determined, it has been estimated to range in the ratio of 25 to 1 in very prolific ground, to 50 to 1 in ordinary mining. Of course in such a great quantity of waste rock, under the present system of working, many small veins or portions of veins are not removed, owing to the expense and difficulty attending such operations by hand labor only—and the great heaps of waste material have accumulated till they now occupy large areas of valuable ground. As in the case of the drilling and hoisting, however, where hand labor has been obliged to give place to steam and compressed air, so, also, very shortly the breaking and cobbing must also be done by machinery, and with proper appliances, with a great saving of expense, as has resulted in the case of the drilling and other operations; since with a properly equipped mine the cost of production can be reduced from 50 to 75 per cent. from the expense due to the laborious system of hand labor.

The history of asbestos mining presents some points of

interest in view of the rapid growth of the industry. Comparatively little importance was attached to the mineral, from the economic standpoint, in the early days of the Geological Survey's operations, and this combined with the fact that, although asbestos had been known before 1850 in the serpentines of the Eastern Townships, the quantity seen at the places where discovered was very limited, and led to the result that but little heed was paid to its occurrence. In 1877, owing to the burning off of the forest in Thetford and Coleraine townships, the hills of serpentine became laid bare and the weathering speedily produced the peculiar felting of the asbestos fibre on the surface wherever veins occurred. This was observed by a French Canadian named Fecteau, it is stated, and the importance of the new material was soon ascertained, which resulted in the establishment of mining operations on a small scale in the summer of the same year, by the Johnson's Asbestos Mining Company, although the credit of the first attempt at working should probably be given to the Ward Brothers. The areas in the immediate vicinity were speedily secured and new mines located, since which time the growth of the industry has been constant and rapid, the output increasing from 50 tons only in 1878 to probably not far from 8,000 tons in 1890, while the prices have also advanced within the last year or two at a like wonderful rate, till now No. 1 Quebec asbestos commands probably as good a price in the market as the best Italian, while No. 3 brings nearly as much as was obtained for No. 1 six years ago.

According to the Ontario Commission's Report, actinolite mining in that province was commenced in 1881, since which time about 3,000 tons have been extracted. This material, however, does not command the price of the Thetford mineral, selling at about the same figure as the waste or No. 4 from that locality, it being used almost entirely for asbestos roofing, for which purpose it is mixed with tar, as already stated, and then applied in a coating of about half an inch in thickness. The waste from the mines of the Eastern Townships, and formerly the output graded No. 3, was at one time quite extensively used for the same purpose.

The asbestos of Templeton was probably first mined in in 1883, but the industry has never proved very remunerative, owing to the limited nature of the deposit and the smallness of the veins, so that for some years mining was entirely abandoned. During the last season, however, operations have been started anew, and some very excellent fibre taken out, it is claimed at a profit. The conditions under which the asbestos occurs in this district are distinct from those which are found both at Kaladar in Ontario and in the serpentine areas of the Eastern Townships, the serpentine in which the asbestos veins occur being intimately associated with crystalline limestone, and in many places the latter is highly serpentinous. The fibre of the asbestos is distinguished from that of Thetford in having a marked pearly and wavy lustre, in being generally lighter colored, and by an entire absence of impurities in the form of iron grains. Sufficient study of these peculiar rocks has not yet been made to pronounce definitely upon their probable importance, but when the deposits are made more accessible considerable mining will be done, as these appear to be quite extensive.

As for the uses of asbestos, these have multiplied with exceeding rapidity. The early history has been briefly stated, in so much that sufficient acquaintance with its peculiarities had been learned many centuries ago to enable it to be woven into cloths often of considerable size. At the present day the finer grades and longest fibres are still somewhat extensively used for weaving into cloths, from which drop curtains for theatres, suits of clothing for firemen, and various other articles, are made, among which are asbestos mail bags for railway transit. So important is the matter of fire protection in theatres now regarded in the leading cities of Europe and the United States, that special legislation has decided that asbestos curtains of a size sufficient to completely shut off the stage from the body of the house must be a part of the stage furniture. As an instance of what can be woven from this material, it may be mentioned that the curtain of the Academy of Music, Philadelphia, by which the stage is separated from the body of the house in case of fire, is 54 feet wide and 53 feet high, and is made almost entirely of pure asbestos, only 3 per cent. cotton being employed, presumably to facilitate the weaving.

As a protection for firemen asbestos clothing has been proved to be of the greatest advantage. By its aid they have been able to enter burning buildings and approach so closely to the flames as to extinguish them in a much more speedy manner than by the old plan of fighting them at a distance. Of a somewhat similar character are the fire shields, also made of asbestos, which are placed between the burning building and those who are fighting the flames, thus protecting them largely both from the great heat and from the dense volumes of smoke as well. As for the great heat which can be endured when clad in these garments, the story of the extinguishing of the Coste gas well in western Ontario only last year is quite fresh in our memories. Here the huge jet of gas which issued from the stand-pipe of the well became ignited, and the screw-cap which closed the pipe having received some injury could not be adjusted so as to effectually close the orifice. Several expedients were resorted to in order to arrange the cap successfully, till at last, under promise of a heavy reward, some one, clad in an asbestos suit, boldly approached the flame itself, a thing absolutely impossible without the protection thus afforded, adjusted the cap properly, screwed it on and extinguished the ignited gas. But while the use of this material for the purpose of clothing has steadily increased within the last ten years, so many other needs have arisen to which it appears especially adapted, that the manufacture of clothing is forced to take a comparatively unimportant place. Thus in chemical laboratories fine asbestos cloth, or even finely teased out asbestos fibre, is now used very extensively for filtering various solutions for which no other material yet discovered has been found so well adapted, especially for strong acids and alkalies which would quickly destroy the ordinary filtering paper. The advantages of the asbestos filter are also apparent in the fact it can be ignited without being consumed. It is also rapidly coming into use in sugar refineries for filtering the saccharine juices, and as a filter for water it has been found to possess very superior qualities over most of the substances in use, and will doubtless, before very long, become an important agent in the purification of our supply of water in large cities.

Its value as an ingredient in the manufacture of fireproof paint has already been alluded to slightly, in which respect it ranks with steatite. Applied to woodwork it is capable of successfully withstanding a very considerable volume of flame and so confining the fire to a limited space. As a material for fire escapes also, owing to its very considerable tensile strength, it is largely made into rope, the fibres of which are sometimes strengthened by the addition of brass or copper wires, from which ladders are then made, which are practically indestructible. More recently, also, its properties as a non-conductor of electricity have been discovered, and a great demand has sprung up for it in the construction of dynamos, and other portions of electrical apparatus requiring insulation. Wall paper, also, printed in ornamental colored patterns, which when applied to the walls of a room reduce the risk of conflagration to the least possible degree, are manufactured even now in considerable quantity, and even writing and fine printing papers are made which have the property of resisting destruction by fire, and though becoming altered to some extent, even then preserve the writing or printing which has been made on them. A great difficulty, however, in the former case is to give the paper a sufficiently hard and smooth glossy surface over which the pen can glide freely; but this defect will doubtless be remedied in time, and with a fire proof ink the preservation of deeds and important papers can thus be readily effected.

To those affected with cold feet a stocking or insole of asbestos cloth, which is easily made, is a sure preventive of discomfort. This article has already been manufactured by an enterprising firm and a patent taken out theron, while a thin strip, used as a cork sole, will be found highly efficacious in keeping one's feet comfortable. While, however, the uses to which this peculiar mineral appears to be adapted are manifold, possibly the most important and valuable is that to which it is now so generally applied, viz., as packing for cylinder pistons in steam engines, and for joints in gas, steam and hot air pipes. In the manufacturing of steam packing good fibre is required capable of spinning. The mineral as it comes out of the rock in vein form is first pulled apart and the fibre teased out into a woolly or silky mass. Then, by specially prepared machinery, the gritty and iron particles are carefully eliminated, since their presence would be productive of injury to the rapidly moving polished piston rods, and the resulting product, a fine fluffy substance, is then carded and spun into yarn or woven into cloth.

If the former, the yarn is treated after the manner of manilla and manufactured into ropes of various sizes and shapes, as required for the different varieties of packing into which it is to be made. In order to adapt the mineral to special uses the fibres of the asbestos are frequently intermixed with fine wires of copper or brass or associated with rubber. In some varieties also finely divided graphite enters into the composition, presumably to impart greater lubricity to the material. The great value of this packing arises from the fact that it is unacted upon by steam or heat, and consequently retains its elastic properties for a very long time in comparison with the old style of hemp or rubber packings; so that now, especially since the late improvements in engines of the marine type where enormous power is developed, such satisfactory results could not probably be obtained by any other known substance.

As a covering for steam pipes and boilers it has also come into very general use, the saving in fuel and power from its application far more than repaying the cost of the material, and is estimated to be not less than 30 per cent. of the energy developed.

But it would be practically impossible in a paper of this kind to enumerate the uses to which this wonderful material is now being applied, and concerning the adaptability of which fresh discoveries are being made almost daily. The great importance attached to the deposits in the province of Quebec is seen in the fact that several of the largest companies interested in the manufacture of asbestos products have found it to their interest to secure mines of their own in this district, among which may be mentioned the Bell's Asbestos Co. and the United Asbestos Co., of London, Eng., and the great German firm of the Wertheims, of Frankfort, while American firms are also largely interested in several of the mines. In spite, therefore, of the wide geographical distribution of the mineral, it is evident that the asbestos of this country has, from its excellent qualities and from the ease with which it is obtained, risen to this prominent place, and in view of the fact that the sources of supply appear to be limited, it is doubly important that in all mining operations the minimum of waste should be permitted by the employment of the most improved machinery applicable to the purposes of mining and dressing, consistent with its economical and profitable output. This view of the case is now rapidly engaging the attention of those who possess the keenest insight into the great possibilites of this industry, and rapid strides have taken place in this direction during the last two years.*

I trust that sufficient has been said in this paper to show that in asbestos we have a substance which is almost unique in the mineral kingdom—a substance of such ready adaptation to such a variety of uses that its neglect for so many years seems wonderful to those who have but superficially glanced at the subject. Doubtless, however, the great expense attendant upon its use prior to the discovery of the deposits of Thetford and Coleraine, in Quebec, is largely accountable for this state of things, and as in the case of many other substances when once they have come into general use, one wonders how the manufacturing and commercial world ever got along without them. It is possible that within the capacious bosom of mother earth there are stored up other treasures of the mineral kingdom whose uses are also unknown at the present day, but which await the fortunate coming of some clever genius to show their great importance. A very striking case in point is seen in the enormous nickel deposits of Sudbury, and, to go a little further back, in the great petroleum wells and the reservoirs of natural gas of Canada and the United States. In fact nature seems to delight in astonishing us at intervals with the production of some new material which almost revolutionizes the existing methods of work; yet it is equally certain that, just as soon as these substances are discovered, the inventive genius of man proceeds to find out some process by which they can be utilized. It will not do, however, to conclude absolutely that, because asbestos at the present day appears to fill a want which is apparently incapable of being filled by any other known material, this condition of things will continue forever or even for any very great length of time. Scientific investigation in the various branches of manufactures and arts is progressing at so wonderful a pace that one ceases almost to be astonished at each successive and brilliant discovery. It is gratifying to know, however, that all such discoveries, whether in the domain of medicine, electricity or in any of the branches of applied science tend to the increased welfare, comfort and advancement of the human race, and to those engaged in the solution of the problems which are constantly being presented in the different fields of scientific research, the thanks of all men are due as to the world's greatest benefactors.

Examination of Mines.*

By Prof. H. S. Munroe.

(Continued from page 33).

FORMATION OF MINERAL DEPOSITS.

The engineer should, of course, be familiar with the literature of ore deposits, and fitted by practical experience in mining operations and by training in field geology to make an intelligent examination of the deposit.

The engineer should not be too hasty in his generalizations, and should bear in mind that similar deposits may have widely different origin, and even that parts of the same deposit may be due to different causes. Deposits of magnetic iron in some cases may be altered bog deposits, or metamorphosed beds of carbonate of iron, originally of chemical origin, in other cases they may be purely mechanical deposits concentrated by the action of running streams,† or again, in other cases, it is possible that they may have been formed by replacement, or deposited from solution in cavities and fissures, or part of the deposit may be due to one cause and part to another, as at Iron Mountain, Missouri.‡

In the examination of a mineral deposit the engineer should be careful to observe and to record his observed facts without bias or prejudice in favor of one theory or another. He should form his conclusions with great care and deliberation. A theory is of value mainly as a means of bringing disconnected facts into some kind of arrangement, so that they can be studied, and is useful only so long and so far as it accounts for the phenomena observed.

In no department of mining engineering is there greater opportunity for brilliant professional success; and in none has failure from hasty and crude generalization proved more disastrous.

MEASUREMENT OF DEPOSITS.

In the case of coal seams and similar deposits, the volume of mineral within the limits of the property may be computed with great accuracy. The areas of coal within the lines of outcrop may be determined by measurements on the map. The surface and underground explorations should give data to estimate what part of this area may be regarded with safety as workable. The average thickness will be obtained from numerous measurements.

A seam of coal of 1.3 specific gravity will contain about one hundred and thirty tons per acre for every inch of thickness. For other densities multiply the specific gravity by one hundred. Allowing for pillars and waste in mining, the common practice of estimating one hundred tons per acre per inch of thickness, approximates very closely to the probable yield.

In irregular coal basins, as in Pennsylvania, the volume of mineral is obtained by developing the warped surface graphically and multiplying the areas thus ob-

* School of Mines Quarterly.

† H. S. M., School of Mines Quarterly, vol. iii., p. 43.

‡ The "Iron Mountain Mine," Prof. W. B. Potter, Am. Inst. Mining Engineers, New York meeting, September, 1890.

tained by the average thickness,* or the method suggested by Mr R. P. Rothwell may be used, and the horizontal area underlaid by coal multiplied by the thickness of the bed or beds measured vertically (instead of normally to floor or roof as above).

MEASUREMENTS OF IRREGULAR DEPOSITS.

Metalliferous deposits as a rule are much less regular in thickness than coal seams. Certain precautions should be taken to secure accurate results. When the variations in thickness are great the prismoidal formulat may sometimes be used to advantage and limited portions of the deposit computed separately. In other cases the average thickness may be used. To obtain this accurately the measurements averaged should be as nearly equi-distant as possible, and greater weight should be given to measurements on a mid-section, than to those on the boundaries. The determination of the average thickness, and the areas required by the prismoidal formula, will be facilitated by carefully constructed cross-sections of the deposit.

Sometimes the thickness to be considered is modified by special conditions. For example, the vein may be very thin and yet workable, as is often the case in gold and silver mines, and in rich deposits of the other metals. In such cases the width and height of the workings will be constant and independent of the thickness of the mineral, as enough broken rock will have to be mined to enable the men to enter and work.

In like manner when the ground is traversed by well defined fissures parallel to the vein, it may be necessary to mine the barren rock up to this fissure in order to make the workings safe.

Again, where the vein or bed is split and the portions are separated by a "horse" or "parting" too thin to be left standing, it may become necessary to mine this rock with the ore.

In all such cases the mining and handling of this barren material must be taken into consideration, and the necessary measurements made, so that its amount and its effect on the average richness of the material mined may be determined.

DETERMINATION OF WORKABLE AREA.

In the case of a uniform and persistent bed, horizontal or slightly inclined, the total workable area may be assumed to be that contained inside the outcrop and within the property lines. If the bed lies at an angle, allowance must be made for the inclination.

In the case of a bed or vein dipping at a high angle we may have another limit, that fixed by the maximum depth at which the mine can be worked with profit.

In the case of less regular deposits, the workable area within the above boundaries, that is, the proportion of this total area that can be profitably worked, must be more or less a matter of uncertainty until the workings actually traverse the whole area. This, in most cases, does not occur until the deposit is nearly exhausted and the knowledge is of little practical value.

Sometimes we can form an estimate of the relative areas of workable and unworkable ground from that portion of the deposit which is exposed by the exploratory workings. A careful study of these developed portions of the mine will often reveal the laws governing the distribution of the useful mineral so that the future may be predicted with some confidence. Estimates thus made may be sufficiently trustworthy to be applied to the undeveloped portions of the mine.

Variations in thickness and in richness or quality of the mineral are often sudden and unexpected. Large barren or unworkable areas are liable to occur, or the deposit may come to an abrupt end. The estimates of mineral in undeveloped portions of the mine and the values deduced therefrom are of necessity speculative. This should be made very clear in the report on the property. The value of an engineer's estimate of the speculative value of the property, as opposed to the wild guesses of interested and over-sanguine parties, has been pointed out.

ORE "IN SIGHT."

In the case of very irregular deposits, isolated ore-bodies, lenticular masses, chamber deposits, bonanzas in veins and similar deposits, the continuance of which in depth is uncertain, it is unsafe to estimate on more mineral than that proved to exist by the exploratory workings. Many engineers prefer to take this course in all cases, and estimate the value of the mine from the mineral "in sight." The term mineral "in sight" is variously interpreted by different engineers, but can be defined as the mineral which can be proved to exist, the nature and amount of proof necessary varying with the character of the deposit.

In most cases, the mineral to be "in sight" should be exposed on at least two sides by workings more or less parallel and not too far apart. For example, the coal between two parallel gangways; the mineral between the uncovered outcrops and an underground level; or the ore between two inclined shafts in the vein.

It is not safe to estimate on mineral exposed on one edge only, as the edge exposed may chance to lie along the boundary of large unworkable areas.

The workings should not be so far apart as to leave chance for unworkable ground between.

To lessen the chance of unworkable areas within the body of ore "in sight," many engineers demand that at least three sides shall be exposed by workings. For the same reason it is well to connect the parallel workings by others at right angles, winzes, cross-headings, etc., and thus divide the deposit into rectangular blocks exposed on four edges. This will be a necessary preliminary to working the deposits in any case, and has the added benefit of securing better ventilation of the exploratory workings.

When a portion of the deposit is exposed on two adjacent sides only, *e.g.*, by a shaft and a drift, or by the outcrop and a shaft or a drift, it is customary to estimate as "in sight" the triangular area bounded by the workings in question and a straight line joining the ends of the same.

SAMPLING AND ASSAYS.

The samples required for assay to determine the quality or richness of the mineral should be taken at numerous points, and so taken as to represent the average value of the deposit at each point. When different benches or different zones of the deposit vary in richness or in quality, the samples from such sub-divisions may be taken separately at each place.* Different benches of a bed of coal may differ greatly in character, amount of ash, of sulphur, of volatile matter, etc. It is not necessary or desirable, however, to subdivide the samples taken, unless the benches can be kept separate in mining.

With the above exceptions, the samples taken at any one place should represent the whole deposit, from foot to hanging-wall.

In coal and soft ores, a uniform groove for this purpose is cut with a pick or with a hammer and moil, across the face of the deposit.

If the material is harder, one or more blasts may be fired with light charges of explosive, so as to break up and shatter the face without completely dislodging the fragments. Chips and splinters may now be broken from the loosened fragments which are still in place, or as they are taken down, so as to give the required average sample.

If the deposit is very wide and uniform, samples may be taken at intervals from foot to hanging-wall instead of in a continuous groove.

If the mine is being worked, samples should be taken from the mine-cars, from the dumps and stock piles, as a check on the results.

The conditions under which the sample was taken, the manner of taking and the amount of ore represented by the sample, should be noted in every case.

SALTING.

The engineer must use due precaution to detect and guard against fraudulent practices. If a sufficient number of samples be taken underground, and these be taken arbitrarily, and not at points suggested by interested parties, successful "salting" will be made more difficult. Such preparation of the mine is generally on a small scale and at few points. A thorough sampling of the mine makes it necessary to do the work of salting on a large scale. Careful examination of the deposit at the selected points, before taking the samples, will generally detect the fraud.

A more dangerous practice, and one more difficult to guard against, is the salting of the engineer's samples during the process of sampling, or subsequently. Sealed bags and boxes are not always sufficient protection against this form of fraud, as the sample may be "doctored" with strong solutions of the precious metal. It is possible again to prepare a mine for examination by concealing the poorer portions of the vein with timbering and loose rock, leaving exposed the richer stopes and treadings only, suspending the work in those places when and where the showing is best.

When fraudulent practices are suspected, the engineer should advise the leasing of the mine by the intending purchaser with privilege of working for six months or a year, in which time the fraud, if any, will be exposed.

EXAMINATION OF PARTLY EXHAUSTED MINES.

A mine that has been worked for a number of years is a less valuable property in exact proportion to the amount of mineral that has been mined. Such a mine, however, has been thoroughly proved, and much of the mining risk attending the development of a new property has been removed. A well developed mine, for this reason, usually commands a much higher price in the market, even though a large part of the deposit has been exhausted. The examination of a partly worked property will be conducted on the lines above laid down for a developed property, with the following additions:—

1. An examination and survey of the abandoned workings as far as accessible.
2. A study of the history of the mine, total yield, average richness of the ore, etc.
3. Investigation of details of working, cost and profits.

The survey and examination of the old workings will determine what reserves of rich or low-grade ore exist in the form of pillars. The examination and survey will also show the condition of the abandoned workings and how far the safety of the whole mine may or may not be endangered. If there is danger of a general crush, or if the shafts or main gangways of the mine are threatened, the cost of making the mine secure must be estimated.

Finally, this examination and survey of the old workings will furnish data from which to estimate the total amount of material excavated, which, with the measurement of the waste rock in the dump-heaps and underground, will serve as a check on the statements as to ore treated or shipped, and will show what proportion of barren material has to be mined with a given amount of ore.

Finally, the underground survey will show what area has been mined and the proportion of available ground remaining.

It will frequently happen, especially in old mines, that the abandoned workings will cave in, or are inaccessible, so that the survey above outlined cannot be made or can be made only in part. In such cases, the necessary information often can be obtained from existing maps and other sources, and the desired estimates of area, if not of volume, can be made.

The history of the mine, its total yield, the cost and profits of mining etc., should be obtained by examination of the mine books, of official reports, the books of transportation companies, of smelting works; and from such other sources as may seem reliable. From this material, it should be possible to obtain the total production of the mine, the average cost and yield per ton, the average selling price and profits; and such other data as will be of service in estimating the value of the mine, and the probable profits of working.

Finally, a careful investigation should be made of the methods of working and of the details of management, that possible improvements and sources of economy and of increased profits may be indicated.

EXAMINATION OF ABANDONED MINES.

The re-opening and working of abandoned mines is attended with more than ordinary mining risk, and the examination of such properties demands great care and good judgment. The larger and more important the mine, the longer it has been worked and the more ore it produced, the greater is the mining risk.

The mine, in any case, is partly worked out and is by so much the less valuable; and it is possible, and in most cases probable, that the deposit is practically exhausted.

Even in the most favorable cases, the cost of re-opening the mine will be very great, and usually will be more than the cost of opening and developing a new deposit. The mine must be drained of water—in itself an expensive operation. The shafts and drifts must be re-opened and generally re-timbered. As it is quite likely that the pillars and arches have been robbed before the mine was abandoned, much of this work will be through fallen ground and very expensive. Finally, the hoisting engines, pumps and other machinery, will have to be repaired or replaced.

As it is probable that the work of exploration and development was suspended some time before the mine was finally abandoned, so it is probable that much exploratory work will be necessary to prove the existence of valuable mineral.

It is not probable that any part of this expense of re-opening will be paid by mineral extracted.

Finally, the working expenses will be greater than in a new mine, especially in the items of drainage, tramming and hoisting, and timbering.

There are cases in which the mines may have been left in more favorable conditions and in which the risk of working will be less.

In countries liable to political disturbances, mines have been abandoned during war time and not subsequently re-opened. In the western mining regions the ravages of hostile Indians have had a similar result.

Mines are sometimes temporarily abandoned because the conditions were unfavorable to success. Situated in remote regions, the cost of the transportation of the necessary supplies and of the products of the mine may have been too great to allow of profitable working. Or again, on account of the undeveloped character of the region a market for the product may have been lacking, or may have been so remote as to be unavailable. With the construction of railroads and the development of the country, such mines can often be re-opened and worked with profit.

Finally, it often happens that mines worked with insufficient capital, or under bad management, are abandoned, and later under more favourable auspices they are re-opened and yield large profits.

The examination of an abandoned mine is one of the most difficult problems likely to occur in the practice of the mining engineer.

It is probable that all the available ore has been taken out, and that even the pillars have been robbed before the mine was abandoned. There is no ore "in sight," and little or nothing left to give an idea of the average value of the deposit. Before the closing of the mine it is probable that the advance headings, shafts, drifts, etc., were suspended, one by one, as the prospects became less favorable. Nothing but poor ground is likely to be found. Finally, the workings are probably under water and inaccessible.

Under such circumstances it will not be advisable to go to the expense of draining the mine until a preliminary examination has been made. In this preliminary examination the engineer must depend almost entirely on the past record of the mine. The evidence, however, is likely to be fragmentary and incomplete; the books in all probability have been lost or destroyed, and but little documentary evidence remains. The engineer will be forced to collect such information as he can from trustworthy sources, and weigh the evidence carefully before submitting an opinion.

Even after the mine is drained a final examination and report cannot usually be made until the mine is developed to a certain extent by exploratory workings.

In the work of re-opening an abandoned mine, the

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* *Second Geological Survey of Pennsylvania*, Report A. A., p. 107. Also "A new Method of Mapping the Coal Fields of Pennsylvania." *Trans. Am. Inst. Mining Engineers*; February, 1881.

† See *Trautwine's Pocket Book*, p. 160, and *Treatises on Railroad Surveying*.

* See paper by D. H. Browne, "Distribution of Phosphorus in the Ludington Mine" *Trans. Am. Inst. Mining Engineers*, vol. xvii., p. 616.

greatest care should be taken at each stage of the operations to minimize the mining risk by limiting the expenditures at any one time to such amounts as the prospects of success seem to warrant. At first the explorations should be in one or two places only; later, if the developments are favorable, a larger force may be employed and the opening of the mine may be pushed more rapidly. Permanent improvements which may be necessary for active work should not be undertaken until there is sufficient mineral "in sight" to warrant the expenditure.

SCALE OF OPERATIONS.

The proper scale of operations is determined mainly by the size of the deposit, and by the probable life of the mine. In certain cases the market for the product, and the effect of a large production on the selling price, must be taken into account.

The size of the deposit limits the scale of operations chiefly by limiting the number of men and machines that can be profitably employed.

The shape of the deposit also has its influence. For example, a lenticular mass, narrow and thin in proportion to its depth, like a bean-pod suspended by one end, cannot be worked continuously on a large scale, as there will be room for but one or two working parties on each level. Worked rapidly, one level will be exhausted before the shaft can be sunk to the next.

A regular bed or vein can be worked from several shafts and on several levels at the same time. A large working force can be employed and the scale of operations will be limited only by the size of the property and the amount of capital.

The thickness of the deposit limits the working force at each point of attack and the amount of mineral which can be broken at a single blast. The total value of the deposit, and the probable yearly profit, limit the amount of capital that can be employed (and consequently the scale of mining operations) by determining the amount upon which interest can be paid, and which can be extinguished by a sinking fund during the life of the mine.

The degree of mining risk involved will limit the amount of capital that can be safely invested with any prospect of its being returned to the investor before the mine is exhausted. The uncertainty as to the continuance of a deposit is a maximum in the case of an undeveloped property: so it is especially important to proceed cautiously at the beginning of a mining enterprise, and by working on a small scale at first, limit the amount of capital subject to risk of loss. Later, when the work of exploration has shown a reasonable certainty of several years' supply of mineral, a larger amount of money may be risked, and the work of development pushed more vigorously. In exceptional cases, the mine will itself furnish the necessary capital.

With the exceptions and limitations above noted, it may be stated as a rule, that the scale of operations should be as large as possible, and the mine worked as rapidly as circumstances will permit.

The advantages of rapid work on a large scale are the following:—

1. The cost per ton of mineral is less. There are certain fixed expenses, such as pumping, ventilation, superintendence, taxes, office expenses, etc., which are nearly the same whether one ton or one thousand tons be mined per day. Again, it is cheaper to work the plant to its full capacity. For example, in the case of a hoisting plant, the same number of engineers, firemen, bank-men, bottom-men, etc., have to be employed, whether one hundred tons or one hundred and fifty tons be hoisted.

2. Rapid work decreases the cost of maintaining the shafts, gangways and levels, of renewing timber, of removing falling ground, etc.

3. More capital is required for work on a large scale, but the amount does not increase in the same proportion as the output. The capital is redeemed in a shorter time, and the total interest charge is very much less.

The Mining Prospects and Industries of West Algoma.*

HENRY M. Q. SEWELL, D.L.S.

HISTORY OF THE MINES.

Mining on the north shore of Lake Superior is of a comparatively recent date, which is somewhat remarkable as there are numerous evidences of mining by the aboriginal inhabitants in Isle Royal, where old workings, in which were stone hammers and other crude implements, have been found. The honor of the first mineral discovery on the North Shore was, however, reserved for Colonel Prince, who, in 1845, whilst searching for copper at Spar Island in Prince's Bay, found a vein of grey copper ore carrying a high percentage of silver. In 1846, Professor Sheppard was employed by the Montreal Mining Company, to explore and locate mineral lands along the North Shore, resulting in the taking up of twenty-seven large blocks of land, and some islands near them, but no mining work was done on them at that time, principally owing to the extreme difficulty of reaching Lake Superior with supplies, there being then only small boats on the Great Lakes, and these were only available as a means of transit for about six months in the year. From this time hardly anything was done until May, 1865, when the McKellar Brothers discovered the Enterprise mine, in the Township of McTavish, of galena ore carrying lead and silver; and in the year following they found the Old Thunder Bay mine in the Township of McGregor, containing native silver and argentite, and the Shuniah or Duncan mine, in the Township of McIntyre, also containing native silver and argentite. From this date, 1866, commenced the first boom in silver mining in Algoma district, which drew a large number of American capitalists to Port Arthur (then called Prince Arthur's Landing), resulting in large tracts of land being surveyed. The discoveries were frequent and rich until 1868, when a man named Morgan, in the employ of the Montreal company, discovered the Silver Islet vein on a small rock included in the company's land. In 1868 also a large deposit of baryta was found on McKellar's Island, but nothing was done of any importance with it until the past year, when considerable quantities of baryta were taken out and shipped to the United States. The vein is about 40 feet wide and of excellent quality. The next important discovery was in 1870, when Silver Harbor or Beck mine in McGregor Township, Pie Island and Cloud Bay were brought to light. Native gold was first found at the Huronian mine in the Township of Moss and at Partridge Lake in 1872. Considerable work has been done on the Huronian mine, and a ten stamp mill has been erected, but although there can be no reasonable doubt as to the value of the mine, still it is so difficult of access that it will not pay to work until it is reached by the Ontario and Rainy River R.R., when the author believes it will become a good dividend paying mine. With the termination of 1872 came the end of the boom or second period of the mines. Mining on the American Continent was as yet a very crude science, and of the experts who came to Port Arthur in those days but few understood their business; miners were paid exorbitant wages, and the general idea seemed to be to put up expensive buildings, and to drink champagne. When to all this was added the heavy cost of transport by the Great Lakes, it is to be little wondered at that one by one these promising mines expended their money and shut down, with the single exception of Silver Islet, which continued operations until March, 1884, when mining operations came to a close for want of coal to supply the pumping engines. The mine by that time had attained a depth of 1,230 feet, and had yielded from first to last about $3,250,000. That one mine, under able and skilful management, has been able to present such a wonderful record, would lead to the belief that some of the other silver mines were capable of producing valuable results, had they been as skilfully managed. Their failure is, therefore, much to be deplored as, once a mine is closed down, there exists a considerable difficulty in raising it again to a working basis, especially as such a result can rarely be obtained except by a change of ownership and the formation of a new company. After the close of the second period, in 1872, there appears to have been but little interest taken in mining enterprises until 1882, when Rabbit Mountain was discovered by Oliver Daunais, a trapper, who was shown it by an Indian. The extraordinary richness of this mine again revived the dying interest in Algoma silver mining, which has resulted in the discovery and working of the Beaver, Badger, Silver Mountain East, and Silver Mountain West, besides numerous other claims which have been more or less developed, and many of them with very encouraging results—such as the New Thunder Bay mine, Crown Point Palisades, Big Bear, Elgin, Silver Fox, and the Ottawa mines, which are amongst the most promising. The New Thunder Bay presents the novelty of being the only vein that contains chloride of silver, added to which it has unexceptional advantages for cheap mining operations. In 1884, the Zenith mine, containing zinc-blende with 58% of zinc, was discovered about 8 miles north of the mouth of Steel River, on the north shore of Lake Superior, about 6 miles east from Rossport, on the C. P. R., where some test pits were sunk and a large quantity of ore taken out. This mine could undoubtedly be sold and profitably worked, but the owners, like the dog in the manger of the old fable, will neither work it themselves, nor allow others to do so.

Many veins containing zinc-blende have been found in West Algoma, but the difficulty is to obtain zinc-blende carrying a sufficient percentage of zinc. A single discovery of mica was also made in 1885 on Dog Lake, but it has not been considered of sufficient value to be even surveyed. Iron was known to exist throughout a large portion of West Algoma, but nothing of any importance was done in this direction until 1885, when the author surveyed an extensive magnetic iron property on the Attic Okan River for Messrs. Graham and Horne. In the year following the author also surveyed a large tract of iron lands, chiefly hematite ore, but containing a percentage of magnetite, on Hunter's Island, and since that time very considerable areas of iron lands have been taken up both on the Lower and Attic Okan ranges.

Native copper, it is strange to say, was never found in paying quantities in West Algoma until the summer of 1889, when some large deposits in the shape of veins were discovered in the neighborhood of Cloud Lake in the Township of Crooks. To complete this abbreviated history of the mines of West Algoma, it may be desirable to give a short account of the gold mines or, rather, gold prospects on the Lake of the Woods, where so far there has been literally no attempt at legitimate mining, the discoverers appearing to consider their bare discoveries worth a fortune without making any attempts to develope them. Amongst these was the Pine Portage, which was discovered in 1880. After going down about 100 feet and putting up a 10 stamp mill, it was abandoned although the prospects were most encouraging. The Winnipeg Consolidated was discovered in 1881, a shaft was sunk 135 feet, when it was shut down owing to the company getting into litigation. Near this on Hay Island is the Partridge Nest or Keewatin, consisting of two good looking veins, 3 to 4 feet wide, which intersect each other at the water's edge. A little development has been done. It is a fair prospect, and free gold can be readily panned from the surface dirt. The Sultana, also near Pine Portage, is a promising property, carrying free gold in paying quantities. It is somewhat remarkable that all these discoveries have been made within a limited area which could be covered by an ordinary township of 36 square miles in area. A few other discoveries have been made, such as Gold Hill, Minerva, and a location of Oliver Daunais on Clearwater Bay, but it is problematical whether any discoveries outside the Pine Portage circle or block will ever pay to operate, though of course it is within the bounds of possibility that some of them may prove exceptions to the general rule, and turn out paying mines. One thing is, however, certain, that mining operations on the Lake of the Woods will be extremely limited and confined to a very small area unless some entirely new field is discovered. Gold in paying quantities appears generally to be found only in contact veins, occurring between the Laurentian and Huronian formation, whereas this condition does not appear to be necessary in the case of silver bearing veins in West Algoma. Last fall several deposits of nickel—which has long been known to exist in the district—were discovered at Schreiber, which are fully as rich as the Sudbury ores.

THE SILVER ISLET MINE

Is situated on a small rocky islet about a mile out in the lake, off Thunder Cape, in the Township of Sibly. The vein strikes N. 35° W., and dips to the S. E. at an angle of 70° to 80°, averaging in thickness about 8 to 10 feet, varying in some places from 20 to 30 feet of solid vein. The gangue of the vein consists of calcite, quartz and dolomite, the latter varying in color from cream to pink, according to the amount of manganese. It carries native silver, argentite, galena, blende, copper and iron pyrites with marcasite; it is also said to contain rodochrosite, tetrahedrite, domeykite, and niccolite, and cobalt bloom, and a peculiar mineral called macfarlanite, containing arsenic, cobalt, nickel and silver. Two new minerals, called by Dr. Wurtz, huntelite and animikite, have also been found in the ore, and the latter three were in 1881 the principal silver ores of the mine. The rock on the Islet intersected by the silver vein is a chloritic diorite forming a dyke. It differs somewhat from the rocks of the other dykes of this locality, amongst which may be mentioned corsyte and anorthite porphyry. The mine attained a depth of 1,230 feet before it was closed down for want of coal, and it was then still yielding silver. The total yield from first to last was about $3,250,000. Numerous attempts have been made to trace out the vein but without success until last summer, when a vein was discovered on Edward's Island, 9½ miles from the islet, averaging from 3½ to 4 feet in width, and which is supposed to be a continuation of the famous Silver Islet vein. It crosses a series of hornblende porphyritic trap dykes, each one of which has faults, and it has been traced across the island; a well defined outcropping shows on the north point of the island. The gangue of the vein in the shaft is composed chiefly of calcite with some quartz and baryta, heavily mineralised with galena, blende, iron and copper pyrites and nickel. At a depth of 20 feet a seam of arsenical silver and nickel came in and is continued down as depth is attained. Selected samples assayed from 40 to 130 oz. of silver to the ton. The shaft is now down to the level of Lake Superior, and is making 30 barrels of water daily. The vein is in many respects similar to the Islet. The same graphite dyke and again macfarlanite have been found, together with rich minerals of cobalt and a peculiar discovery, native arsenic in all its forms, crystalline and reniform or shelly. This arsenic contains a varying amount of silver, from a few ounces to many hundreds. The arsenic in itself is not new, but where it has been weathered by exposure the skeleton of native silver stands out on the black arsenic in mossy or dendritic masses of beautiful appearance. It seems this vein was known to the Indians who resorted there for medicine, carefully hiding the place on leaving, which perhaps may account for this vein not having been found before.

THE OLD THUNDER BAY MINE

Is situated in the Township of McGregor, not far from the eastern limits of the Township of McIntyre. The vein strikes N. 34° E., and dips at a high angle to the N.E., and consists of closely reticulated veins of white granular quartz, the largest being about one inch thick, and the aggregate average perhaps ten feet long. It carries native silver and argentite, accompanied by galena blende and iron pyrites. The ore occurs in bunches three to eighteen inches thick by six to forty feet in length, the silver being in strings, leaves, grains, &c., irregularly distributed through the vein stone which constituted the greater part of the bunch, the silver often forming ten per cent. of the mass. The work done consists of four shafts sunk on the vein, and a cross cut driven N. W. at the 10 fathom level and some drifting between the two deepest shafts. No. 1 shaft is about 70 feet deep, No. 2 is the same depth, 300 feet north-east of it, whilst 150 feet further on is another shaft 35 feet deep, and again, 150 feet to the north-east on the strike of the vein, another shaft has been sunk to a depth of 25 feet. A very considerable quantity was taken out of this mine, but much of it was stolen, so that it is difficult even to approximate the amount. Unfortunately in addition to this the mine was mismanaged from the first, but, had it been otherwise, it is thought by many that it might have even rivalled the Silver Islet mine.

* Paper read at the annual meeting of the Dominion Land Surveyors, February, 1891.

THE SHUNIAH, OR DUNCAN MINE,

Is situated in McIntyre Township. The vein strikes nearly east and west, and has a general dip to the south at a high angle from the horizontal. The total width on the surface is 20 or 30 feet. Several cross lodes intersect or run into the main vein. The gangue is quartz, holding small quantities of galena, blende, and pyrites, and also calespar. There is no pink spar as at Silver Islet, but there is a considerable amount of purple amethyst. The formation of the enclosing rocks is almost precisely similar to that of the Old Thunder Bay mine. There was a considerable quantity of silver taken out of it, but mismanagement resulted in the vein being lost, and it has been estimated that when the mine was shut down that they were fully 400 feet off the vein.

THE BECK, OR SILVER HARBOR MINE,

Is situated in McGregor Township, further east than the Old Thunder Bay Mine. The vein runs E.N.E., dipping at a high angle to the N.W. It has a brecciated character and is about 5 feet thick. The gangue consists mostly of white granular quartz, but barite, calcite, fluor and amethyst are present with much iron pyrites, galena and blende. The silver occurs mostly as argentite, but also in the native state. The country rock is much the same as Old Thunder Bay mine, and consists of smoke colored cherts and argillaceous shales, running nearly horizontally under what appears to be a bed of coarsely crystalline trap. The junction of the Animikie and Huronian lies about half a mile to the north of the mine. The vein showed a considerable quantity of silver at a depth of 40 feet, but it was badly mismanaged and was shut down without ever having had a fair trial.

THE "THREE A" MINE.

This property hardly deserves the name of a mine. The vein strikes N. 75° E., and dips slightly away from the vertical. It is from 18 inches to 2½ feet thick. The gangue is mostly quartz with a little calcite, through which are irregularly distributed ores of iron, copper, lead, zinc, nickel and silver, with some cobalt and gold. The ore was very rich, and samples assayed 1.4% of cobalt and 25 of nickel. The silver was however very pocketty, and eventually played out after about $2,000 worth of ore had been taken out.

JARVIS ISLAND MINE

Is situated westward of Silver Islet. Considerable work has been done on it. It runs across the island in a north westerly direction, and dips N.E. at 50° to 55°, thus contrasting with the nearly vertical dips of the veins on other islands. Three shafts have been sunk, respectively 160, 31 and 78 feet. Unfortunately it appears to have been named solely because of its proximity to Silver Islet, which it somewhat resembles, both with regard to the vein matter and enclosing rocks, with the single exception that it is almost barren of silver. It has always seemed to the author that it was a great pity that so much money was wasted on a comparatively barren vein whilst numerous more promising veins have remained untouched. This, however, happens in almost every mining district, and it is a wonder that the selections in Port Arthur district have generally been uniformly good.

THE ENTERPRISE MINE

Is situated in the Township of McTavish, in Black Bay; the vein is six to eight feet wide, the gangue being quartz and calcite, with a pay streak 3 to 4 feet wide of galena and copper pyrites, with a small quantity of gangue. Prof. Chapman gave an assay from a selected specimen: lead 47 per cent., copper 8 per cent, silver $4 per ton. Owing to there being but little demand for lead at that time, this mine was shut down, but now with the probable demand for galena ores to assist in smelting the silver ores of the Beaver and Silver Mountain districts, it is likely that more attention will be paid to the lead ores of this district, especially as there are one or two promising properties, notably the "Ogema," situated in the northern part of the Township of Dorion, which contains a purer galena with a larger percentage of lead and silver. This part of the country has, however, been but little explored.

RECENT DISCOVERIES OF THE NORTH SHORE.

Although not in the order of discovery, a brief account may here be given of the explorations which have taken place during the past two years over the lands on the north shore of Lake Superior. These researches have been carried on principally on the lands of the New Silver Islet Co., and also in the neighborhood of Cloud Lake in the Townships of Crooks and Pardee, and consist principally of copper, although some silver has been found near Maimainse on the North Shore. The district is one vast bed of native copper ores, the geological structure being similar to that on the south side of the Lake in the Keweenaw district. This belt carries amygdaloid and conglomerate lodes and veins and sandstone. The great upheaval of nature manifest in the structure of the country has lead to a great diversity of opinion regarding the degree of mineral wealth possible in such a formation and during last summer there has been found no less than twelve distinct veins of rich copper, of which number eight are rich enough to form as many distinct mines of a most promising character.

The dip of the country is at an angle of 22° to 33°, and the trend of the strata is southeast and northwest, inclining more northward inland. The strata of the veins run north and south, cutting at angle of about 40° to 45°. The ores found are those known as the horse flesh and the peacock, gray ore and native copper.

These discoveries are all made on the lands belonging to the Silver Islet Mining Company, who own 10,000 acres in that vicinity alone, besides immense tracts of other valuable mineral land in the western section of Algoma district. So thoroughly have the American mineral men informed themselves of the natural resources of the north shore, that they have acquired possession of these grand deposits, while Canadians have held them to be a "God-forsaken country full of barren rocks." It may also be interesting to note that in this section have been discovered several articles of antiquity, such as ancient hand made pottery, ornamented with indentations of the thumb and thumb nail of the potter, copper hammers and other rudely constructed tools and implements of a long-since forgotten race of miners who came from no one knows where. But, like the traces left by these early miners at Isle Royal, and other places along the shores of Lake Superior, it shows that Maimainse did not escape the keen eyes of the copper hunter of those early days, who may have forgotten more about that section of country than the whole of Canada has as yet been able to learn.

With eight richly laden veins of copper in sight and half as many more of a lower grade ready for operation, the Silver Islet Company will begin work next spring for developing some of the long-hidden wealth. Maimainse is 12 miles west of Batchewanin lighthouse, and about 40 miles west from the Sault.

In the neighbourhood of Cloud Lake in the Townships of Crooks and Pardee, a number of copper bearing veins have been found during the past two years. They occur in bands of amygdaloidal trap which carries the metal in a fine state of division of native copper. The country in the neighborhood of Cloud Lake is high and hilly, rising up to a height of 300 feet, and consists of the black slates of the Animikie formation heavily capped with trap sometimes to a depth of nearly 50 feet. Average samples of copper ore from this locality assay as high as 12 per cent. Silver bearing veins have also been found in this locality and some of them have assayed well, so that there is every prospect that it may develope into one of our most promising mining fields.

RABBIT MOUTAIN MINE.

With the discovery of this mine in 1882, mining in this district came once more to the front after a lapse or rest of ten years (the natural result of inexperienced, and, one may almost say dishonest mining).

The conditions of this group are somewhat different from former discoveries in being further removed from the northern boundary of the formation and from the outcrop of the lower siliceous division. They are all in the upper argillaceous division with its associated trap sheets, the argillites being soft and black.

The vein of the Rabbit Mountain strikes N. 35° 45' E., and dips at an angle of about 65° to 70° to the N.W. The vein is a composite one consisting of a number of branches and stringers interlaced and is about 4 to 6 feet thick, although much wider in places. The ore consists of native silver and argentite, accompanied in considerable quantity by blende with a little iron pyrites and galena, and occasionally copper pyrites in a gangue composed of quartz, calcite and green and purple fluorite. A good show of rich ore was found on the surface, and caused considerable excitement in the district. Several shafts were sunk on this property, and a stamp mill erected with a capacity of 15 tons per diem. Capt. McComber, who was manager in 1886, claimed that the concentrates ran as high as $4,000 to the ton, and averaged $1,500, the milling ore averaging $80 to the ton. In addition to this a considerable amount of ore was rich enough to be shipped in barrels, parts being almost pure silver. Although more silver has been taken out of this mine than would repay the entire expenditure, the mine was closed down in the fall of 1887, owing to a disagreement amongst the owners, with the view of freezing out some of the weaker owners, and from that date this very promising property has remained idle.

BEAVER MINE.

The next mine of importance is the Beaver, which was discovered shortly after Rabbit Mountain, and work was commenced in 1884. The work was continued on a small scale until it was sold to an American capitalist in 1885. Two veins have been worked in this mine. The main vein cuts in a N. W. direction across a ridge about 200 feet high, having a steep bluff to the N. W., whilst it is intersected about 300 feet in from the face of the ridge by a cross vein running in a north easterly direction. The cross fissure is very irregular and hard to follow, varying from a few inches to almost nothing. It was followed for about 350 feet, but as it carried but little mineral it was left. The main vein averaged 4 feet. The gangue of the vein consists of yellow and dark colored blende with some iron pyrites and a little galena, calcite, amethystine quartz and a little fluorite, which is mostly green but sometimes purple. The silver occurs in the ore bunches chiefly as argentite, in nugget, sheet and leaf form, with some native silver. This mine has been worked longer and more extensively than any other mine in that district. It has always been owned by private capitalists, who, owing to its extreme richness, have been loath to place it upon the market. It is consequently rather hard to get reliable information regarding it, but suffice it to say that the vein has been followed with the diamond drill for over a mile, and although it has been extensively worked, it still continues to turn out large quantities of bonanza ore, which is shipped away to the smelters, besides a large quantity of milling ore, for which purpose they have an excellent mill about half a mile from the mine. This winter is the first that they have attempted to work it all the year round, the mine having previously been shut down during the worst of the winter. The monthly shipment from this mine varies from $25,000 to $40,000.

THE BADGER

Is the next of this group of importance. It is situated in the Township of Gillis, in near proximity to the Beaver and Rabbit Mountain. It is an exceedingly rich property, being very rich and full of black nuggets of silver, and has more than twice paid for the money expended by the original shareholders. It was discovered about the same time as the Rabbit Mountain, but it was so capped over with trap that it was only fairly brought to light by Mr. Eishweiler, an American explorer, who in 1886 sunk a shaft in the property which resulted in a good looking vein being found, and which has resulted in the formation of the mine into a stock company. Under vigorous development it soon asserted itself as one of the most wonderful silver ore producing mines on this continent. In 1890, the Porcupine, an adjoining property, was purchased for $50,000, containing the continuation of the vein which is about 3½ feet wide and extends on the property for a distance of about 3,000 feet. The vein consists of argentite, black blende and galena, with large nuggets of black sulphide of silver, calcite, amethystine quartz and a little fluorite, mostly green, but sometimes purple. The vein has been pretty thoroughly explored by means of shafts and adits. The mill puts through about 35 tons daily.

SILVER MOUNTAIN EAST END.

The next in order is the Silver Mountain East End. It was discovered in 1884, but although some $12,000 was spent in trying to develope it under option by some Cleveland capitalists, they failed to discover anything of value. After they had given it up the original owners discovered native silver in large quantities a few feet from where the Cleveland company had left off, resulting in the sale to an English company in 1887, who have since that date been continually working it. They have now discovered no less than 9 veins on the property all bearing silver, and at 800 feet down they have discovered immense bodies of native silver. The main vein is about 4 feet wide and consists of native silver blende, black and brown, a little galena, with a gangue of calcite and amethystine quartz, with a little fluorite, mostly green.

WEST END SILVER MOUNTAIN.

West End Silver Mountain is a continuation of the same vein as the East End. The average of the vein is about 6 feet here, the nature and composition of the vein being almost identical with the East End. This property has been sold during the past year, and developments are being pushed rapidly forward. The author may here remark that there are numerous valuable locations and veins in the Silver Mountain and Beaver districts which space will not permit of description in detail, amongst which are notably the New Thunder Bay mine, owned by a company in Minneapolis, the Crown Point and others. But suffice it to say that in this district there is not a single instance of a failure where any development has been done outside of the most superficial character, which speaks much for this but little known district, especially when the history of the mines in the east around Port Arthur has, with the single exception of the Silver Islet Mine, been one continuous record of disaster and failure.

As lead ores are of importance in the smelting of silver, it may be interesting to note that there are several good sized veins in the neighborhood of the Townships of Dorion and McTavish, notably the Ogema, which has been recently bought by Philadelphia capitalists, who propose putting up a smelter on the property next summer. The vein is a very strong one, running parallel with a high granite ridge, and occurs along the line of contact of the granite bluff and the gneiss that forms the valley below. The vein outcrops about half way up the bluff, and is partially covered by fallen rocks and debris. Its strike is a little north of east and south of west. The pay strike is about 14 inches wide at the surface, and nearly solid galena. About 20 feet below the outcropping an adit has been run, cutting the vein at this point two feet in width, and carries richer ore at the surface. The galena is of a very high percentage. Assays from the surface outcropping showed it to carry 24 ounces of silver to the ton.

Before entering into a description of the iron ores of the district, it may be interesting to note the discovery of manganese in paying quantities, an ore which is so much wanted in the production of the higher grades of mild steel. The following is an account of the discovery made during the past summer by the employees of the New Silver Islet Co. At Cape Gargantua they discovered a vein of hydrated black oxide of manganese 7 to 10 feet wide. It rises out of the lake and crosses a large island. The vein rises up like a dyke from 4 to 10 feet above the surrounding country rock. In many places the quartz is weathered out and the manganese ore left standing. The manganese is on both walls of the vein, and a strong seam or band is distributed through the middle of it. The ore assays 45 per cent. metallic manganese. The importance of this discovery can be appreciated, when the quantity of iron already known to exist in this district is taken into consideration. Last but not least in the list of Algoma minerals stand forth the iron ores of the Thunder Bay and Rainy River districts, which bid fair to take the lead of the iron mines of the world whenever facilities are opened up with the United States for the free transportation of iron ores. Amongst these the Attic Okan iron beds are the most remarkable. The first of these locations was surveyed in the summer of 1886 by the author. The property was shortly afterwards examined by Mr.

D. H. Bacon (now superintendent of the Minnesota Iron Co.), and on his report bonded for a long term to a Cleveland party. No active operations having been begun, the discovery of the iron did not attract general notice in any way until the finding in 1889 of another rich deposit, several miles further west on the same range. The result of this was the starting of numerous exploring parties, and the discovery of still other outcrops of the same ore further westward, until now these rich deposits have been traced by outcrops for a length of 30 odd miles along the belt.

Nothing more than a superficial examination of the deposits has been made, in the way of a few surface cross cuts and an occasional shot to secure unweathered samples; but in many places the ore outcrops boldly, showing a varying width of from 10 to 50 feet. These outcrops occur in veins or lenticular beds in the Huronian formation lying between the Huronian trap and chloritic schists, which are nearly vertical, having a dip of 86° north, and a strike of N. 75° east. The surface showings indicate that there are several of these beds, the intervening rock having a width of from 5 to 30 feet. Whether these beds will unite at a depth or maintain their separate identity, is a problem for development work to decide. The Huronian belt has an average width of eight miles, and rest conformably in the folds of the Laurentian rocks, so we may presume its depth (and that of the imbedded magnetite), to be very considerable, practically unlimited. The Graham property is the most easterly on the range, and its most conspicuous outcrops occur on the summit and both faces of a bluffy ridge running nearly east and west 100 feet above the level of the Attic Okan river. Mr. D. H. Bacon sampled the surface showing here, taking samples at three inches intervals, and for an aggregate width of 80 feet these samples gave 63½% metallic iron without more than a trace of phosphorus and little more than a trace of sulphur; no titanium. The outcrops here showed three beds of ore.

Immediately west of the Graham property is Sabawe Lake, a sheet of water three miles in length. For some distance west of the lake, in the course of the iron belt, a considerable depth of soil covers everything; this extends to location R. 400, on which, and R. 401, other outcrops occur very similar to those on the Graham property. A similar ridge traverses these locations, and in many places, especially on the southern exposure, which is very steep, large outcrops occur. The ore throughout this range varies but very slightly in character or grade; it is virtually identical throughout, though in some places, where greatly exposed to atmospheric action, it is of course leaner. On location R. 400, where a natural exposure of ore some twenty feet in width occurs, a large number of samples taken at random gave from 66 to 68½% metallic iron. On the location west of this, R. 401, a surface cross-cut was made this summer, which showed 46 feet in width of ore; the full width was not ascertained, as the cut was abandoned on account of the depth of overlying soil and large boulders. Some of the ore from this cut, when protected by deep soil, gave as high as 71% metallic iron. A little more than half a mile west of this the ore again outcrops on the south face of a ridge about 50 feet in height, the intervening ground being low; samples from here gave 35%. Half a mile further west a short trench dug in the low ground showed rich ore at a depth of only 3 feet. No attempt was made to uncover the width of the deposit, the sole object being to locate it. A mile beyond this, numerous showings are found along the top and south face of a ridge about 100 feet high; the surface showings here are very extensive, and the ore of the same high grade, 66-68%. For nearly 3 miles beyond this the ground in the line of the deposits is very low, and no attempt to locate the ore by test pits, etc., has been made. As the ground rises, the ore again outcrops and shows at the crossing of the Attic Okan River, which is very rapid at this point. About 1½ miles further west lie the Garland locations, on which there is an outcrop of magnetic iron ore, uncovered, from 25 to 28 feet in width across the ore formation and about 400 feet in width. Owing to the small amount of work done, the walls on either side have not been found. This outcrop is about 10 feet above high water mark, and on the bank of Attic Okan River.

Assays from this ore body, made by the Sharon Iron Works, Pennsylvania, gave the following results:—

Metallic iron	68·76
Silica	1·41
Phosphate	0·006
Sulphur	0·185

Mr. Hill, assayer, Port Arthur, gave a result of test of same ore of 67·75 metallic iron. Mr. Rossman gave 70·8 metallic iron. The formation of the iron range is invariably almost vertical. On lots 111 E. and 118 E. there is a very large ore body of magnetite. This outcrop or bluff, which is situated about half a mile north of Attic Okan River, rises to a height of from 125 feet to 175 feet, and is in most parts covered with vegetation. A trench about 6 feet wide, extending from the top and across the ore formation 135 feet, and measured from the top to the base gave 210 feet at an angle of 45°. The length by survey is almost half a mile. The ore body presents the same characteristics as 109 and 110 E. and results from an assay made by Prof. Hays, of Toronto, gave 68.67 metallic iron. The surrounding country is well timbered with tamarac, spruce, pine and birch.

These four 80 acre locations extend along the range for one and a half miles. Exploratory work has only been done in two places, but the ore body is plainly visible in many places on each of the locations.

The author has also surveyed three more locations for Mr. Garland, in which the ore changes, over part of it, to hematite, but still of the same high quality; and to give a faint idea of the value and extreme purity of these ores, annexed is a short report by Mr. J. C. Thomas, an American expert, together with copies of assays over different parts of the belt; and it may here be remarked that they show conclusively, by the entire absence of titanium and the low percentage of sulphur, phosphorus, and silica, that they are essentially high grade Bessemer ores.

DETROIT IRON MINING COMPANY,

MR. LEE BURT, Manager,
Detroit, Mich.

DEAR SIR,—On my return from Port Arthur I give you a report of my examination of the iron property in the Rainy River district, on the Attic Okan River, known as the Garland property. I was very much surprised to find such fine outcroppings of iron ore. It was beyond all expectations. The iron range, running about east and west outcrops at an elevation of 125 to 175 feet, and 1,000 to 1,500 feet in length, showing very fine quality of ore, such as you will see by the samples. Sample No. 1 was taken from about half way up and partly across the top of the bluff, a distance of about 135 feet on the ore formation. Sample No. 2 was taken from 10 feet above the surface of the river, a distance of 25 feet across the ore formation. The exact width of the ore can't be given, as there is not enough work done to uncover the ledge. If in case these samples should not go as high in iron as may be expected, I don't think it ought to be any set back to the property, as better results would be reached in opening up the ore body. These samples were taken from the surface of the ledge. The results of the samples you will please add to this report. If the property should open up as well as I expect it will, and I have every reason to think it will, the ore can be mined and put into the cars for 35 to 50 cents per ton at a large output. No definite estimate can be given as to the size of the ore body or to the amount of ore that can be produced until more work is accomplished.

Yours respectfully,
J. C. THOMAS.

Ishpening, Mich., Aug. 25th, 1890.

Assays of Attic Okan Magnetite—Graham Locations.

	Averages by Mr. D. H. Bacon. (1)	(2)	(3)	Chapman.
Silica	6·60	7·30	5·89	2·43
Alumina	1·09	1·80	·98	0·67
Ferrous ox	....	....	....	23·32
Ferric ox	87·66	86·90	88·36	46·74
Manganesic	trace	trace	trace	....
Calcic	1·28	0·90	1·40	....
Magnesia	0·75	0·60	0·75	....
Phosph. acid	0.079	0·069	0·025	....
Titanic acid	none	none	none	none
Total	94·46	97·57	97·41	
Metallic iron	63·47	62·84	63·97	70·06

The first three are averages from the three beds sampled by Mr. Bacon, and the last is a single specimen given Prof. Chapman of Toronto.

Locations R. 400 and 401.

	Assayed by Minnesota Iron Co.	F. Hill, P. Arthur.	H. M. Currie for Carnegie Bros.
Metallic iron	68·50	65·90	65·701
Silica	2·90	5·80	4·20
Phosphorus	0·015	0·001	0·003
Sulphur	0·052	0·16	not specified
Titanic acid	none	none	none

Assays by Sharon Iron Works, Pa., of samples furnished by Capt. M. N. Garland, as from property marked "Garland Locations":

Metallic iron	68·75
Silica	1·41
Phosphorus	0·006
Sulphur	0·185

Assays of Attic Okan ore by Geological Survey of Canada. —Dr. Hoffman, Assayer.

1. Magnetite from R, 402:
   - Metallic iron 68·579
   - Titanium none
2. Magnetite, R, 400:
   - Metallic iron 68·027
   - Titanium none
3. Magnetite from R, 403:
   - Metallic iron 64·551
   - Titanium none
4. Magnetite from line between mining locations 10 E. and 11 E., collected by Smith:
   - Metallic iron 65·710
   - Titanium none

There is also a very fine deposit, or rather vein, about 30 feet wide which occurs on the line of the Port Arthur, Duluth and Rainy River R.R., and contains magnetite carrying 56 per cent. from average assays of the surface. Nor are these the only deposits of Bessemer iron ores to be found in this district, there being heavy deposits on Hunter's Island on Gun Flint Lake, and near Kaministiquia Station, which are all reported as being valuable. Railroad communication is of course absolutely necessary for almost any kind of mining, so as to afford the means of cheap transit, but this is particularly so with regard to iron ore. For this purpose the Port Arthur, Duluth and Western R. R. is being constructed from the shores of Lake Superior, at Port Arthur, to the American boundary at Gun Flint Lake, and branching from this road the Ontario and Rainy River R.R. is being surveyed to communicate with the gold fields in the Township of Moss and the iron fields on the Attic Okan River. With regard to the market for these ores, and the cost of delivering them thereat: Mining will cost from 75 cents to $1 per ton, say $1 as an outside estimate; railroad freight to Port Arthur or Fort William, $1 per ton; lake freight to either of the principal ore ports on Lake Erie, Cleveland or Ashtabula, may be taken as the same as that from Ashland or Two Harbors, the shipping ports of the Gogebic and Vermillion districts. The rate last year and during the past season has been about $1.25 per gross ton, and there is no reason to think this will be exceeded in the future, considering the continual increase in number and tonnage of vessels built on the lakes. Shipping charges, insurance, etc., may be taken at 30 cents per ton; duty going into the United States 75 cents per ton. This will give the total cost delivered at a Lake Erie port of $4.30 per ton. The present value of a high grade Bessemer ore, such as this under consideration, delivered on the docks at Cleveland or Ashtabula, is $6 per ton, which would leave a net profit of $1.70 per ton. So that even with the American high tariff of 75 cents per ton, there is no reason why these ores, and particularly from the Attic Okan range should not be mined at a profit.

In conclusion the author thinks it is safe to predict that before the lapse of many years, West Algoma will take a prominent place amongst the ore producing districts of the world. So far the diversities of ores that have been found are so great, that there can be but little doubt that when the country is more carefully explored by practical prospectors, many ores that have hitherto been unsuspected, will be found; and with development numbers of rich mines will be discovered. Canada as an ore producing country has in the past been sadly neglected, and although our neighbors south of an almost imaginary line have been developing and bringing to the fore the mineral wealth of that great country, we with far richer mineral wealth have so far hardly touched our resources. This, we might almost say, fatal national apathy can hardly last much longer, indeed it is in a measure fast disappearing, and when it does disappear, the author is confident that West Algoma will produce almost untold wealth. In dealing with so large and extensive a subject the author has found it necessary to condense considerably the information he has obtained regarding the mines, for to describe some of them properly would afford a fit subject for a paper alone, but the author will always be happy to afford any information in his power to anyone seeking information on this very interesting subject.

PORT ARTHUR SILVER SHIPMENTS.

Silver shipments from Port Arthur District, Jan. 1st, 1890 to Jan. 1st, 1891, to the U. S. A. as per U. S. Consular agency reports:—

Beaver Mining and Milling Co	$ 80,000
Badger Silver Mining Co	95,500
West End Mining Co.	2,750
	$178,250

N.B.—East End Silver Mountain Co. ship all their ore direct to England. The amount shipped is not known, but it is safe to estimate it at not less than $50,000.

Titles to Mining Property in Nova Scotia. *

BY B. C. WILSON, WAVERLEY, N.S.

One of the most important considerations in connection with the mining industry in Nova Scotia is the validity and permanence of the titles; and this applies to both the land or surface privileges and the mineral right, which by our laws are held separate and distinct.

The days of individual effort in mining, and the investing of labor only instead of capital have passed, or at least are rapidly passing away, and the absorption of the smaller holdings by capitalists and associated companies into larger properties is taking its place, and the investing of large amounts in initial outlay for plant and development, which increased depth of workings and consequent larger operations render necessary, brings the value of the titles very prominently to the front.

According to our laws, the minerals, with few exceptions, are vested in the Crown, and the land or a major part of it, having passed out of the Crown, and being held by individuals in fee simple, it is evident that the claims of the miner and the land owner must frequently clash.

When gold was discovered in the Province and licenses to work were issued by the Government, this difficulty was recognized and met by the Government buying up the grounds in the proclaimed gold districts, or "revesting," as it was termed, and the Government recouped itself by charging applicants for mining leases the relative amounts paid per acre for these grounds, in addition to the $2 per area mineral charge, thus granting a mining lease with a soil right for twenty-one years.

This, though it involved an initial outlay of from $8 to $10 per area, was eminently satisfactory to the miner, as the validity of his title was assured.

This method was pursued at Tangier, Sherbrooke,

*Read at the regular meeting of the Gold Miners' Association of Nova Scotia, October, 1890.

Waverley, Ovens, and other places; but later on the revesting method was deemed injudicious, and the law of "arbitration" between the several lessees of mining lots and the owner of the land, was substituted.

This system still prevails, and while its advocates claim it works comparatively well it is undeniable that in many instances it is alike unsatisfactory to the miner and land owner, and has resulted in much friction and litigation, and as the principle of that law and its results develope and become more generally known, that friction and litigation will increase.

So long as the mining locations are confined to uncultivated or "wild land" the solution is comparatively mutual and easy, but when they encroach upon cultivated grounds or, as in some cases into the gardens and even dwellings of the *bona fides* land owner, very naturally the spirit of resistance is aroused, and whether legally, judiciously or otherwise, instances are not wanting of great acrimony and almost armed persistence in opposing the presence of the miner, and the constitutionality of our Statutes may yet have to be referred to the Privy Council of England for adjudication as to whether a person can be ousted from his legally acquired estate and be obliged to take such remuneration as a committee of arbitration may award him, particularly as the individual may be an unwilling partner—or even refuse to be a partner at all in such arbitration.

The State reserves to itself the right to acquire any lands required for national or public welfare—as for instance for defence or public buildings, for highways and railways, but in this case our Statute provides for an arbitrary use and occupancy of one man's property for another man's convenience or profit.

Recently our Local Government have seemed to take the ground that in granting a mining license, they are simply giving a quit-claim deed to a prospective but undefined property, something on the principle they sometimes dispose of cattle on the western prairies—"sell them running, and let the purchaser catch them if he can." But the result of such an irresponsible course cannot but result disastrously alike to the individual and the Province. Let it once be known abroad that a Government title to a gold mine is only a purchased law suit, and how much foreign capital will find its way to the Nova Scotia mines? In short, it is an untenable position which the Government cannot afford to hide behind, and it is only a question of time, perhaps, when our legislature may have to face the question of how far they are responsible for having granted a mining lease to a person who has not brought evidence of having made his peace with the owner of the land, and having taken his money and granted such lease, how far they are committed to put him in possession of his property instead of leaving him to fight out a tedious and expensive law suit—of which there are instances at present existing.

In the matter of the grounds before referred to, which were bought up by, or revested in the Government (and on which the applicants paid for the ground as well as for the mining privilege), it is pertinent to remark that when these leases lapsed by expiration of term they were renewed at $2.00 per area for mining lease, nothing being said about the ground, the inference being that the title being in the Government, the soil conditions would remain as formerly, that is reserved exclusively to the use of the holder of the mining lease; in fact to my personal knowledge the mines officials gave this verbal assurance in certain cases.

In the year 1885, however, an act of the Local Legislature (somewhat ambiguously expressed) enacts that "All such revested lands shall be considered and dealt with as Crown Lands," which practically puts these grounds in the market at forty cents an acre to the first applicant, and being so granted it follows that the miner is at the mercy of the land owner and has no right there which such owner need respect, and individuals would not long be wanting who would take up such revested lands on speculation, and already applications with that view have been filed.

To the unprejudiced mind this would appear like arbitrary confiscation of the miner's rights. Protests and objections to such grants have been filed and it remains to be seen what action the Government will take, or whether they will consider the immediate acquisition of the 40 cents per acre paramount to what must necessarily result in curtailed receipts from rents and royalties—not to mention the resultant friction, litigation, delay, and all uncharitableness inflicted upon the individual sufficiently enterprising to invest in mining properties.

I understand however it is the expressed determination of the Government in regard to these "reverted" lands *not to grant the surface to any one without the consent of the mining lessee.*

This is as it should be, and if it so remains, well and good, but to settle the matter so it may not raise its unwelcome presence again, a recorded order-in-Council putting it beyond resurrection should be urged upon the Government while they are in the humor.

Since the introduction of the "Arbitration" law in regard to land titles, the matter has become considerably modified. This law requires the mining lessee to make such terms with the land holder as best he can,—failing in which, *arbitrary* arbitration settles the remuneration, and each individual lessee has to independently settle for his respective areas.

In some instances arrangements were made by consideration for damages,—or by lease sometimes with, and sometimes without writings, in other cases by absolute deed, and still in other cases by no arrangement at all; the parties taking out mining leases of ground on which they never entered, consequently had no immediate need to make terms, and in course of time either transferred or forfeited, and new owners stepped in, until it would perhaps puzzle the original land owner as much as the present mine owner to know in whom the title rests, or how much of the land is vested in the *should-be* owners.

The danger of this state of affairs lies in the possibility and evident probability of parties quietly acquiring these scattered titles, and letting them lie dormant till some development brings the value of the property prominently to the front, when these claimants will spring into active and aggressive life.

I have thus far confined myself to the land titles, but may be allowed a remark in reference to the mineral right.

It is laid down on broad principles that the minerals in Nova Scotia are reserved to the Crown. It should have been added however "with certain exceptions," for it crops out that certain *land* grants made to certain individuals at divers times and places, also conveyed the *minerals* as well, and that large portions of some counties and whole townships are independent of the Crown as regards the mineral rights. For instance, the Township of Truro is said to be so exempt, and there are claimants for the mineral rights at Oldham and Montague, where I believe a decision has not been reached yet; and probably there are many other places in the already worked gold districts where such claims may be, or are set-up; and minerals are now being discovered all over the Province, and in places where mineral rights were considered of no value because none were supposed to exist, and the outcome of it may be that a discoverer may obtain a title or lease from the Government, in good faith, of property over which it is presumed to have control, and may erect expensive works thereon and invest large capital and develop a valuable property, only to be confronted by a claimant with a better title, and be invited to vacate forthwith.

I am not prepared to speak definitely on this point, but am informed that a case of this kind is now interesting the investors, if not the Government, At least it would appear that such a case is quite probable, and if so might form another case where the Government may have to consider its responsibility.

I think it unnecessary for me to enlarge upon the unfortunate results liable to follow this condition of affairs. Our own people who are, or may think they are, conversant with the ins and outs of the situation may not place as much value on the matter of titles as its importance demands, for, whether from want of means or lack of enterprise, the fact remains that our people invest but sparingly in mines, not in gold alone, but in coal, iron and other minerals. In short the bulk of our mining capital comes from abroad, and capital is proverbially cautious, and the perfect title is what the foreign capitalists first look for as the main protection of a non-resident, and it is alike the interest of the Government and the individual to encourage the industry by all legitimate means.

I may just here be allowed to refer to one other feature connected with the business.

It does seem invidious that this one industry should be singled out for special handicapping.

The agriculturist or the lumberman can get a grant and unquestionable title of a hundred acres of land for forty dollars, and proceed to extract as much product as he can, not only without any special tax added, but in some instances gets an actual bonus by way of encouragement, while the miner is charged about $240 per hundred acres for a *lease title of twenty years'* duration, handicapped with a land claim for an unknown amount, and instead of any bonus or encouragement, is mulcted two per cent. on all the gold he extracts or so much per ton on his iron or coal, and gets in return a litigant privilege to fight all comers.

Naturally the miner feels, when paying out so much money he should get some consideration beyond the patriotic privilege of contributing to his country's exchequer; and if this took the form of unquestionable title it would largely soothe the aversion one reasonably feels in paying out money for which he recognises no adequate value or return, but when on the contrary it merely introduces him to unknown annoyance and expense, it simply becomes exasperating, and if applied to any other industry would cause a revolt.

I do not wish to be understood as casting reflections on our Government or even inferring neglect. Speaking personally, I can bear testimony of having invariably found the Executive and the officials affable and ready to deal liberally and equitably within the limits of their jurisdiction, but unfortunately they are not infallible like his Holiness, and with very best intentions for both public and private interests, are liable to oversights and mistakes, and they are hedged by certain Legislative enactments and inherited conditions which makes their position a kind of buffer between conflicting interests, and not a very agreeable position either: wherefore it is desirable and judicious that every individual interested in the success of our mines should use his individual and united intelligence and efforts to suggest and influence equitable legislation for the protection and encouragement of the mining industry, and no one should object to this, for does not the whole community benefit through the mines?

The agriculturist, the lumberman, the manufacturer and the laborer all find customers and not competitors in the mining industry. This is an age of combination, and there is no injustice in miners combining for mutual protection and encouragement, and it is regretable that so little interest is evinced by mining men for their *united* interests. They all acknowledge the desirability of effort and improvement, but fail to exert their influence unitedly. The bundle of sticks lacks the encircling cord of union.

One would almost infer that the main object with all, is rather to bear the ills they have with a true miner's hope by some lucky strike soon to be able to retire, bid goodbye to the business and let the devil take the hindmost.

Another question might also merit the attention of the Government and ourselves as well, being one which will eventually demand adjustment, whether any great financial benefits result from it or not. It is, the ownership of the crushed ores or sands after they have left the mill; for claims have been set by mine lessees that ores of former miners brought from other localities and deposited on these areas previous to the present lessee's occupancy, come under the mining act of minerals and *belong to the* PRESENT *lessee.* The case may be stated briefly. Does the crushing and treating of the ore, for the free, or amalgamatable gold, constitute all the claim the miner has to the quartz his labor or money extracted from the earth? Does the depositing or storing of these sands on another person's property, whether held by mining lease or deed, constitute a trespass, or forfeit the ownership? and if the latter, to whom revert?—to the owner of the soil? to the Government? or the mining lessee? And what about the commercial value of these sands for industrial purposes? for it is a fact they do possess *now* a commercial value which may be increased in the near future.

While it may be conceded that the Government have a claim on those sands for royalty on all gold eventually extracted from them, in consequence of their original habitat or origin, it certainly does not follow that they come under the original intent and meaning of the "Grant" or "Reservation of Minerals" contained in such ground—that is, so far as to again hand them over to another person. The Government has once received its *quid pro quo* for this ore, and has placed no restrictions of how, when, or where it shall be treated.

I take the ground, that ore once legitimately mined is the property of the person whose labor or money produced it, no matter how treated or where deposited, and remains his, both for mineral and commercial purposes, until alienated by sale or abandonment.

What may constitute *abandonment* may require a statutory definition; as to how long a virtual neglect of such sands on lands *not owned* by *the depositor* shall constitute a forfeiture, and then to whom they would revert; also to define what penalty shall attach, if any, for trespass for depositing them on *any* ground; and if on Government soil if any penalty at all shall follow, unless it may be the recouping to the mining lessee for any actual inconvenience suffered by any such deposit post-dating his lease.

There are cases where abandonment may be inferential—as, for instance, A. may take a quantity of ore to B.'s mill for treatment, and the sands are run out to the common receptacle; clearly A. abandons further claim. Again, B. may, deliver his sands directly from his mill into a brook or river, where no accumulation takes place, and they are carried by the current to indefinite distances. The inference is that B. abandons them.

There are also instances in the Province where parties, anticipating results in the future from these sands, after the oxidizing influence of the elements had liberated the gold in the sulphurets, did at the inception of their works purchase ground (irrespective of mineral right) whereon to deposit or store their crushed ores, and where they still remain; the soil title still intact, and the sands never abandoned.

In such cases there can be no question of ownership, and aside from these, I fail to comprehend how the depositing of any *ores* (crushed or otherwise) by A. on B.'s ground gives B. any title or claim to them any more than would the placing of so much *cordwood* or *hay* thereon give B. a title to them. Nor can I understand how the Government can claim such sands—that is, give another mining lessee power over them—unless by some process of abandonment, or law yet to be enacted, they legally revert to the Crown. Nevertheless it is well that these points be definitely settled before investments become involved and litigation follows.

I may further call your attention to another custom in the Mines Office, which to the ordinary layman seems like something which "no fellow can find out." I refer to the apparently unnecessary number of dates used on a mining lease, and to illustrate, quote the exact figures from an existing lease—

We read first, "This Indenture made this 2nd day of October, 1888;" and further on, "To have and to hold for 21 years from 28th August, 1888;" and on the back of the lease appears, "Registered 12th October, 1888."

Now here are three dates employed in conveying a property for twenty-one years. The most prominent one is the 12th October, 1888, but almost any one can understand that date of document and date of registry rarely correspond; but when lawyers get confused, as I know of an instance during the past week, it is not unreasonable that less educated persons should err. The main trouble lies in the two first dates, and there are no valid reasons why the date of Indenture should not correspond with the date of Application, as that was the time the engagement was entered into; and if the Government for their own convenience deferred making out the lease on that day, it was no fault of the lessee.

I am informed a law suit is now pending through this very misleading array of dates. It is a simple matter to so remedy it that none need err.

Another feature in the regulations at the Mines Office I may call your attention to, that is in the matter of the transfers and division of leases; for instance: A. owns a certain mining property held under mining lease in regular form. In the course of events he sells to B, and legally and correctly transfers the same in accordance

with the regulations at the office, and hands over the lease to B. This is the present mode of transfer, and is presumed to be legal and sufficient. B. takes his transfer and lease to the office, and on the record book an entry is made, "Transferred to B. this 5th day of September, 1890," and the original lease is handed back to B. That is all there is about it. B. looks at the lease and finds it is a lease to A., is in A.'s name, and not so much as an endorsement of transfer or anything to show that B. is the now owner of the property designated by such lease.

Now this may be all right and valid enough. But does B. consider it so? And presuming B. is acting for a syndicate or company, what will his associates say to him when he presents a lease showing that A. (not B.) is the recognized owner of the property? To satisfy themselves they would each have to make a trip, perhaps from England or the United States to Halifax and pay 25 cents merely to read thus: "Transferred to B. this 5th day of September, 1890;" and even then does it not carry with it a feeling of insecurity? The only way to remedy it is to surrender and take out a new lease paying $2.00 per area therefor, merely to get the lease into B.'s name. Such a method of extracting money, if practiced by individuals, would be termed dishonest.

And still another case: presuming A. has a lease of 100 areas in one block and sells 50 of them to B., A. makes out a transfer of 50 areas to B, which is duly presented at the Mines Office and recorded as before, and there appears on the records: "Transferred 50 areas (numbered so-and-so) to B, this 5th day of September, 1890." That is all there is to that. B. gets nothing more from the office to show his ownership; he does not get the lease from A.; he does not get even an endorsement placed on A.'s lease to show that half of it belongs to B, but A. still holds the lease, to all appearance unencumbered, of the whole 100 areas, and B. cannot even surrender his 50 areas and get a new lease in his own name, even though willing to pay $100 for it. But A. must do the surrendering, and then it appears that A. cannot surrender 50 areas for B., but he must surrender the whole 100 areas, and this involves another $100 to enable A. to get a renewed title to what he may have only a month before paid his money for, and now have to pay it over again.

Such a procedure among individuals would be designated by the slang term of "snap game," but we are loyally bound to presume that our government, like Cæsar's wife, is entirely above suspicion; nevertheless, they take the money all the same, and the miner discovers that it is pay! pay!! pay!!! eternally, and yet the miner, while asserting that something should be done, does not individually or collectively make much effort to see that that desirable something *is* done.

Now, in reviewing the foregoing I may be reminded that this is taking a pessimistic view of the matter; in other words, "more frightened than hurt." Admitted that it is so, it is indisputable that the fears expressed, if not realities now, are liable to be so, and most assuredly will be as the mining interests develop and properties increase in value, and it does seem as if the public generally look upon the miner—or at least the mining interests—as fair game to be plucked whenever the opportunity offers, and while, as I before remarked, those who administer the government are, I believe, desirous of fostering the industry, yet it is apparent that a great system of oppression and annoyance has grown up with the administration of the Mines Department, for which no one department of the government or any individual is directly responsible, unless it be the miners themselves, who by not offering suggestions to our legislators, or by not timely protesting against repressive or onerous legislation (or *custom* which has grown into power through use and precedent without legislation), have practically sanctioned the existing system. Our commissioners and mines officials cannot reasonably be held responsible for these idiosyncrasies of law and office custom, they necessarily are men quite inexperienced in mining matters and requirements, who have been called upon to inaugurate a new department. Statutes on one side have directed their course of action and their office regulations—(for I consider that many of the regulations enforced there have no legal status beyond what they have acquired through continued observance and no one questioning their validity)—are simply the outcome of the necessity for some method and order, which were from time to time adopted to meet the exigencies of the case, while the parties most interested—the miners—not only did not suggest any matured method, but did not vigorously protest when the practice or law was inimical to their interests, and instead of uniting for mutual benefit and redress, merely contented themselves with some individual grumblings.

The new law of yearly rental of 50 cents an area in lieu of working provides that the lessees shall pay 50 cents per year per area, otherwise the lease is forfeit on expiration of a year and a day. Now presuming A, B, C and D apply for 40 areas and get a lease in joint and equal ownership, and at end of the year C and D decline to renew, that is, pay their proportion of the $20.00 yearly rental. A and B desire to continue and are willing to pay. Now in such case how much, if any, of these 40 areas are liable to forfeiture, and if half of them, which half? And can A and B retain their half and the others be forfeited, or will the whole have to be forfeited and A and B take up what they choose, with the risk of some one stepping in ahead of them, or what course is open to them? Of course A and B can pay the whole amount; but this continues C and D as equal owners *without paying anything*. Of course the government may say "this is a matter of partnership over which we have not control and are not interested." Very true! But the action of the government has yoked them together but has provided no means of divorce. It is going to produce friction and litigation, and certainly it is the duty of the government to so legislate as to reduce rather than foster litigation. For if this thing goes on the result is not far to see, the whole province will become one vast law court, and the revenue from royalties will practically cease.

B. C. WILSON.

SOME MEMOS. OF TITLES IN CERTAIN LOCALITIES.

RENFREW.—The government bought up the land at $4.00 per acre and leased to mining applicant at $10.00 per area, including the $2.00 for mining right, thus making a gentle profit of about $5.00 per acre. In or about 1868 the system ceased, and the government charged $2.00 for a mining lease and left the lessee to settle as best he could with the land holder. But all that the government paid for it holds yet, and of course comes under the Crown Land clause of the Act of 1885.

The Ovens—LUNENBURG.—There was much difficulty here in arranging the land rights, but believe it was settled by the government giving "Misener" so much for the damage done, and allowing him to retain use of his farm subject to all the annoyance the miners see fit to visit on him.

MONTAGUE.—The land was bought by the Government and leased to miners same as Waverley and Renfrew, but a claim to the minerals and land has been set up by the Canal Co., to certain portions, and is still under consideration.

SHERBROOKE.—The land was purchased by the Government or revested but I do not know at what price paid, or charged to the miners.

After the "Arbitration" law came into force, the Government ceased to buy any more land, and any allotment of new areas since come under the Arbitrations scheme.

TANGIER—The land was bought by the Government, but I have not learned how it stands now.

WAVERLEY.—The land was bought by Government at $8.00 per acre and leased to mining applicants at $2.00 per area mining right, and $8.00 per area land right, total $10.00 per area. The Government title was found to be defective, and a large number of areas are now covered by freehold right which the mining lessee has to respect. The rest still remain in the Government, their title to these having been perfected.

OLDHAM comes under the same category as Montague, a kind of triangular contention between Government, Canal Company and the miner. I do not know how it rests, who is uppermost, or whether the miner is on top or between the upper and nether millstone.

SALMON RIVER, having passed through all the trials that opposing limbs of the law could think of, is presumed to have a good title.

UNIACKE.—The titles are considerably mixed. Some of the ground the Government bought and leased with the mining lease at from $4 to $6 per area, and some the lessees arranged for, and for some no arrangement was made. Any mine not much good is presumed to have a defective title quietly slumbering, waiting for the gold to grow.

B. C. WILSON.

On motion, it was voted to refer the above paper to the Committee on Law and Legislation, with instructions to embody in a report some suggestions looking to the remedy of the evils described.

Report of the Committee on Law and Legislation.

(Regular meeting of November, 1890.)

Mining titles in Nova Scotia naturally arrange themselves into classes, owing to differences in mode of derivation, and the variety of treatment that has been accorded to them in different cases.

In the early history of this Province, certain grants were made to favored individuals, where not only the land itself, but also the minerals underlying it, were passed by the Crown in fee under the grant, and as these titles sometimes arise to confound the miner who has paid his money into the office of the Department of Mines, it seems to be the obvious function of the Government to have schedules or tabulated statements prepared, fully informing the public of the particulars of such grants, their location and boundaries, so that no mistakes or losses may arise to innocent persons who may have paid their money in good faith.

Another class of title arose where the lessee of gold mining rights also enjoyed surface rights, under his lease, which conjunction took place where the Crown had revested the land on the discovery of gold, or still held it ungranted, and passed it to the lessee in and by his mining lease.

In all such cases where the Crown has either the possession or reversion of both surface and mining rights it is most desirable that they never should be severed, and to that end the Order-in-Council spoken of by Mr. Wilson in his admirable paper should be passed; or better still perhaps an amendment to the Mining Law should be passed and placed upon the Statute Book.

It would also be a desirable thing if when gold is discovered on ungranted lands they should be reserved for mining purposes within the limits of the new district and be passed under the leases passing mining areas; and we might go further and ask that in all future grants of lands now remaining public property, clauses should be inserted for revesting lands whereon gold may be discovered hereafter under appropriate conditions.

In considering the commonest status of gold mining rights in the Province, we find the miners, as a rule, holding leases of gold areas over land that may belong to anybody. There are no surface rights by virtue of the great majority of these leases. The miner must secure them for himself from the grantee of the land or his representative often at great sacrifice, and always under the penalty of forfeiting his lease if he enters and works without having done so.

The question involves three parties, viz.: The Crown or the Department of Mines, the Grantee of the land or his Representative, and the Lessee of the gold mining areas or his Assignees. The Crown grants the land in fee, reserving the gold and all things necessary to its recovery by mining. It also demises the mining areas subject to the surface rights of the grantee or his representatives. The land holder is subject to the incidents of the mining reservation and the miner is encumbered by his liability to pay damages to the land holder.

But some very material points to the disadvantage of the miner present themselves by comparison of their relative positions. The land owner has received a grant in perpetuity of his land, and no dereliction of duty on his part towards the miner will defeat his title; but if the miner enters on the lands and begins to work his mine without having arranged and settled the damages, his lease is forfeited and his title (defeasable at best) is entirely gone. In point of permanence of title then the land owner holds the coign of vantage. He also is better off as regards his product, for no matter how great the value of his crop, or of his timber or other product, he pays nothing more for it to the Government forever, while the miner has to be taxed by a royalty on every ounce of gold he produces so long as his lease runs, and pay annually commutation called rentals, if his areas are not worked.

One would naturally argue that where the Crown gives such manifest advantages to the land holder over the miner, it had received more money—a greater consideration from him as the price of his grant, but such is not the case, for it has received but 40 cents per acre for an undefeasible title to the soil in perpetuity, while from the miner it has received $2 per area, which is a smaller tract, and (if he cannot work his mine), fifty cents per area for each year's occupation, not to speak of royalties. There is surely great inequality here.

Of the three parties the Crown has decidedly the best of it, and considering the larger amount of money the miner pays, it does seem as though it should ensure to him a larger measure of protection and greater help in fighting his battles; but we do not think it has done so in the past, for in addition to discriminating against him in the matter of money payments, he is ever and anon on the brink of forfeiture. If he does not work he is liable to forfeiture, and if he works without having settled damages he is alike liable. It seems to be a case where the Government, which is so great a gainer, ought to bear the responsibility of securing to the miner his dear bought rights, by undertaking to settle land damages, instead of leaving them to be settled by its lessee. There can be very little doubt but that they could be settled more certainly and reasonably by the action of the Government, and with less litigation, and it is the duty of the law giver to prevent lawsuits and not to encourage any system that fosters them, which that now in force certainly seems to do.

It may be worth discussing whether the appointment of a government arbitrator would not solve the difficulty. It would appertain to this official to assess damages in every case, and in doing so he would hardly trench upon any ground where the Government has an interest. We conceive it has a duty to perform in this matter, having taken the money of both parties, as much from the grantee of the land as if there was no mine in the land, and as much from the miner as if it had not already been paid for the surface, full price in both cases; but whatever interest it might have in the reversion of a lease, or a grant, would hardly be affected by any question of damages between the two contestants, always assuming the statutable mode of arbitration to be legal and constitutional.

Any form or class of lease is subject to forfeiture, and insomuch as forfeiture affects title, it is suggested that instead of forfeiture, some other penalty, perhaps money damages, be inserted in the Act by way of amendment, or that any case of forfeiture may be commuted or condoned, by payment of money within a reasonable time. We need not draw upon our imagination for examples of the dangers to titles lurking in the clauses which make forfeiture the penalty for entering and working without settling damages.

There is another aspect to this question of titles that is of unspeakable importance to the gold miner. It is the conversion of our lease-hold titles into fees, so that instead of our present insecurity, we may have, under proper conditions, titles that shall be, when once fully acquired, permanent, perpetual, undefeasible and unforfeitable.

To our mind this is the most vital question we can touch. Its consummation would do more to bring prosperity to our mines by causing the reopening of old mines, the investment of fresh capital, and the prospection of new districts, than any other legislation that could be devised. It would give our mines the same encouragement as is given in other countries, and place our titles on an even footing with theirs. Other things being equal, the money of investors will be placed in a country where it will secure a good and permanent title as against one where the whole investment is liable to be lost by the title being defeated. The risks of mining are great enough underground and miners ought not to be compelled to take additional risks through bad titles. As a matter of abstract justice, the miner has as good a right to be made secure and undisturbed in his possessions underground as

the farmer has to the land he tills in the sunlight overhead.

As before shown, once a grant of land is made no further payments are demanded, but on the other hand the miner must keep on paying his royalties to the end of time, with no diminution as he progresses towards the centre of the earth. Why a tax like this should be kept and put on an industry so precious and so costly to prosecute, especially costly when deep ground is reached, is one of those inscrutable things "no fellow can find out," and we do not believe this system of royalties on gold can be defended on any sound economic grounds in a new country like this, whose natural resources stand so much in need of capital from without and where no reciprocal benefits or countervailing advantages by way of rewards or bounties are ever given or offered to the miner.

Large payments of royalties were made formerly in the palmy days of their prosperity by the Goldenville mines. Afterwards they were all shut down on reaching, for this Province, great depths. We might have expected the Government to offer assistance from royalty moneys to the miner who would undertake to incur the cost of powerful and expensive machinery for deep work, but no such assistance has ever been forthcoming, and those mines are still shut down. The Dufferin mine has paid large sums of money in for royalties—probably not less than $12,000 to $14,000 since the mine was started. For all this money the proprietors have not one solitary material thing to show, nor is there any guarantee, nor even hope, that if their quartz should be exhausted to-morrow Government would advance a single dollar to help render their vast and valuable plant again productive.

We contend that such a condition of things is wrong, and in every sense unsuited to the spirit of modern methods.

Run down the whole gamut of our established industries and you find that the tendency of the times is to give bounties, subsidies and bonuses, in short to deal liberally with capital in order to attract it to development of resources, expansion of industries and support of the population.

Railways and steamships are subsidised by Government. The factory is bonused by Municipalities. Certain industries, discriminated against by Foreign Governments are encouraged by Government bounties at home. But our Government so far from giving bounties, taxes its own miners by a perpetual tax. Only mining is taxed and that by a direct tax on production not capable of being distributed infinitessimally over the great consuming public, as are customs and excise duties, but the tax is imposed so that it must remain fixedly, helplessly and relentlessly where it is placed, and be borne alone by that class that is singled out for the distinguished but invidious privilege of carrying it, and is a strong example, almost the only one, of a thing that will stay where it is put.

As an association of miners, jealous and eager for the standing and permanence of our favorite pursuit, we protest against the continuance of leases and royalties.

We suggest that the mode followed in the Canadian North-West be adopted in its general lines by the Legislature of this Province. The proposed changes would, after the lapse of a certain time spent in development, work being done virtually under license, periodically renewed for a time, not exceeding say five years, fees being paid at each renewal, and the expenditure of a fixed annual sum in developing, permit the holder of the claim to buy the reserved gold mining rights absolutely for a reasonable sum.

In the Canadian North-West, lands containing gold are located at $5 per block of 40 acres. This fee is paid annually in advance each year for five years, if so long desired, but at any time before the expiration of the five years the claim may be bought on proof that $500 has been expended on it.

If not bought earlier, the occupant may each year for five years renew his location receipt, paying $5 therefor, at the same time proving that $100 had been expended on his claim during the year. When he elects to buy he pays $5 per acre, and then gets a title in fee to both land and gold.

Upon this framework, with such modifications as our different circumstances might dictate and demand, we may be able to mould acceptable changes in our laws.

Under our present system mines will no doubt continue to be opened, but very few, if any, will be worked to great depths: they will not gain value by development, and abandoned mines will become the rule rather than the exception, until a more liberal policy shall be inaugurated. And we believe that the needs of the miners require only to be presented to the consideration of the Government to secure every concession we can reasonably ask for.

The matters we have referred to may be taken to have escaped the notice of the Government, who would naturally suppose that any inconveniences in the laws bearing hardly on the miners would be brought to their notice by the miners themselves, and, in the absence of any complaints, they naturally would presume that no grounds for such existed. For such evils as we find, therefore, we think we have our own lethargy and indifference to blame largely; and we cannot doubt of receiving to a great extent, at least, such aid as we may reasonably ask.

H. T. HARDING,
For the Committee.

At the regular meeting of the Association, on December 5 1890, held at the Halifax Hotel, Mr. B. C. Wilson opened the discussion by referring at length to one point not covered in his original paper, viz., the uncertain state in which titles to surface rights yet exist under the Statutes of the Province. On motion of Mr. MacDuff, Mr. Wilson's remarks were incorporated in his original paper.

Mr. J. E. Hardman spoke at some length on the subject. The committee, he said, have recommended that in future all ungranted lands upon which gold has been discovered shall be reserved by the Government for mining purposes, and they shall "pass" with the mining lease. This is altogether desirable, but it seemed to him that the position recently taken by the Government, that no grants for lands upon which gold is known to exist shall issue without the consent of the owners of the mining leases, is broader and is a better solution of the difficulty and one which more completely protects the legitimate miner—of course it is only the legitimate miner that we are considering or can possibly consider. Let the Government take the same position with regard to all ungranted lands that they have taken with regard to the "revested" lands referred to, and let them take a step further and adopt the suggestion of the committee, that in *all* future grants there shall be provision for revesting such part or parts of such grants as shall be found to cover mineral grounds.

For the determination of the value of such revested lands, the idea of a Government Arbitrator (who possibly might also be the Inspector of Mines with advantage) was worth consideration.

He heartily concurred in the report of the Committee in preferring that this change be incorporated in the Statutes rather than be a recorded Order-in-Council; and he also endorsed the idea of having tabulated schedules or plans prepared by the Government, showing the location and boundaries of all grants in which the Crown has reserved no mineral rights. There was one case in Court to-day, and in six months there might possibly be two others, in which it was contended that the original grant conveyed the title to gold and other minerals, as well as to the soil; and in each and all cases the parties now owning had bought such property in good faith that the Government lease-title was a good one, and on the strength of it have spent thousands of dollars in opening and working mines thereon. It did not require sagacity to foresee one of two things, either the extreme embarassment of the Government in having sold what it did not own, or the complete and utter damnation of Nova Scotia gold mines in the eyes of capitalists and honest men.

He desired to state, in reference to the hypothetical case alluded to by Mr. Wilson, in his paper, that B. does get some sort of a recognition from the Mines Office, in the shape of a paper called a "Transfer." But A. apparently has no endorsement on his lease to show that he has sold or parted with the whole or any part. He was sure, however, that this could be easily remedied, through having the blank forms of leases slightly changed. To the characterization of the methods by which the office takes $200 per area on every surrender, he was sure they must one and all cry "Hear, Hear!" It was, as the document said, a decidedly dishonest practice.

There is another practice that he desired to refer to. Mr. Wilson spoke of it in language that was clear and admirable. He said: "Custom which has grown into power through use and precedent, without legislation," and, again, of "regulations which have no legal status beyond what they have acquired though *continued observance* and none *questioning their validity*." By Section 73 of the Mines Act, the course of the Commissioner of Mines is clearly laid down, when, in the case of *forfeitures*, he is unable to decide who is the first applicant for the same. He is, in such case, obliged to *sell* the areas applied for at *public auction*; certainly a mode of procedure which is for the benefit of the treasury of the commonwealth. But in the case of vacant ground, ground that has become vacant by expiration of lease, or has never been under lease, no special direction for the Commissioner's guidance is made. One would suppose that the method prescribed by statute for the one case would naturally govern the other cases, which are of similar nature. Not at all; this infamous "custom" steps in (probably the offspring of some defunct Commissioner, centuries ago, who was too indifferent to do otherwise), and prescribes that it is the regulation of the office that all such applicants for new ground must be united in a partnership in those areas, or at least in a co-ownership,—and thus washes its hands of all trouble. But, as Mr. Wilson says: "the Government has yoked those people together, but provided no means of divorce," unless some one of the co-owners kicks vigorously and goes into court to have such co-ownership dissolved by public sale. So that the Government, by sanctioning such a practice, really gives its approval to "customs" and "regulations," and practices which are illegal, inequitable and unjust, which have no warrant in law or equity, and which encourage expense, litigation and trouble, instead of striving to foster and aid one of the industries upon which their financial credit is based.

Such a case as he described was personally known to him, and not one, but several. That the Commissioner (and by the Commissioner he meant the Department of Public Works and Mines) should attempt without any warrant of law to force unwilling parties into an obligation, which was one of the most delicate of business relations, and one usually safeguarded by extreme preliminary care and caution, was of itself sufficient reason for demanding an immediate and explicit direction by statute of mode of procedure in such cases. But, there were too many of these customs and too little of the spirit of the law; the miner was beset on all sides, and bound with circumscribing cords, until his life was hardly worth the living. One solution, and one only, would cut all these Gordian knots and free the gold mining industry, so that it should have new and trebled life and strength, and that solution was fee simple. Once get this, and all other difficulties would vanish as smoke before the wind.

Mr. MacDuff, of the English syndicate, expressed himself as much interested in the subject. The owners of the property he represented lived in Europe, and he had found considerable difficulty in making clear to them some of the intricacies of our mining laws, and they naturally felt considerable interest in the validity and permanence of their titles; and he further made some comparisons between our mining laws and the more elaborate and definite statutes and regulations in Australia, where he had spent several years, and where the best mining talent and experience of the country had been employed to draft the statutes and administer the law, and considered that much of their legislation and practice might be introduced in Nova Scotia with advantage, and promised to favor the association, at a future meeting, with some transcripts and data from the antipodean colony. He endorsed the remarks of Mr. Wilson referring to surface rights, speaking of the ownership of tailings which were deposited on the surface of areas other than those owned by the mill owners, maintaining that the present lease gave right to all gold *upon* as well as under the surface. He advised the adoption, modified perhaps, of the Australian plan, of each owner voluntarily registering his tailings at the Mines Office, paying therefor a certain fee.

Mr. Partington referred to the necessity of a revision and simplifying of the mining laws and mines office practice, and instanced the objection frequently raised by capitalists and prospective investors in the United States, to what they considered the insufficiency of transfer titles and the manifest injustice of some of the regulations or requirements of the Mines Department. Referring to Mr. MacDuff's remarks regarding the ownership of tailings, he objected to this plan of registration, maintaining that the Government took enough money out of the gold miner already. He also maintained that under the statute, surface gold or alluvial mines should be taken up under a separate lease. See sections 1, 10, and 12, chap., R.S.

Mr. Hardman concurred in this construction of the sections referred to, and said it was a matter of doubt whether the wording of the lease and the words of the statute were not in conflict. The matter, if ever worth the while, would probably some day be referred to a court for construction.

Mr. Fisher said the Department had informed him that there was no conflict between the lease and the statute.

Mr. Stemshorn said the discussion showed that the mining law was faulty, as new points came up under it every time it was discussed. He, for one, had never known before of the distinction in classes of areas, as shown by sections 10 and 12.

Remarks were also made by Messrs. Reid, Harding, Archibald, McDonald and others.

President Stuart considered the matter one of vital importance, not only to the mining fraternity, but to the provincial welfare in general, and suggested that the papers and the expressions of the members of the Association present be compiled and printed for distribution, in order to induce a more general interest in the gold mining industry and its requirements, and if possible, elicit from practical mining men suggestions of needed amendments to the mining laws, and induce combined action by those interested,—which was unanimously approved.

It was also resolved that the Secretary send a copy, with the report of committee and discussion, to each member of the Provincial Legislature.

The Copper Deposits of the Province of Quebec.*

DR. R. W. ELLS, OTTAWA.

(Continued from page 34.)

On the east half of lot nine, range eleven, the Brome Mining Co. also sank a shaft sixty feet deep on a bed of variegated and vitreous ore in similar nacreous slates, of which it was supposed three feet of the rock would carry three per cent. ore. From this also no returns are available, and in the south-east half of lot seven, same range, explorations on a four foot band in chloritic slates yielded, according to Mr. Chas. Robb, a considerable quantity of ore.

In the adjoining township of Brome, mining was carried on at several points. On the east half of lot five of the fifth range, the yellow and variegated sulphurets were found in three bands, varying from two to thirteen feet thick, supposed to be repetitions of one and the same bed through undulations of the strata. Three shafts were here sunk by the Canada Copper Mining Company to a considerable depth, and a large quantity of ore, estimated at three per cent., extracted. Machinery for crushing and concentrating was erected, but the company soon ceased operations.

On lot six, range six, considerable exploratory work was carried on by the Bedford Mining Company, but with no satisfactory result. On the west half of lot twelve, range seven, the Tibbets mine, owned by Messrs. Ball and Morell, consisting of a shaft to the depth of eighteen feet was sunk on a band of yellow sulphuret in nacreous and chloritic schist. On lot six, range seven, the variegated ore was found in two bands, one of which, two or three

*Mineral Resources of the Province of Quebec, 1890.

feet thick, was estimated to carry one per cent. copper; the other band of five feet was supposed to cary one and a half per cent. ore.

On lot eighteen of range eight variegated and vitreous ores were observed to occur in four bands in nacreous, chloritic and epidotic slates, and dolomite in a breadth of several yards, and a small excavation, not sufficient for a test, was made. These ores were continued on lot nineteen, same range, and on lot twenty-one, range nine, but no returns as to value or output from any of these are to hand.

In the township of Shefford mining was carried on at two places only, viz.: by the Glencoe Mining Company, on lot seventeen, range two, where the different ores occur with quartz and calcspar in four separate bands in micaceous and chloritic slate and on lot twenty-eight, range three, by the Waterloo Mining Company, in similar ores, and with similar country rock, where a shaft was sunk to a depth of sixty feet, but no returns are available.

Further north in Stukely, the Grand Trunk mine was situated in the south-east quarter of lot six, range one. A shaft was here put down to a depth of sixty feet on a band of yellow and variegated sulphurets, in micaceous and chloritic slates with dolomite of the usual character. The same bed, with a thickness of three feet, was found on the lot adjoining; some good ore was obtained, but the quantity is unknown. A trial shaft, twenty-one feet deep, was also sunk by Messrs. Lambe and Shepherd in the south half of lot seven, range two, on a band of fifteen to twenty feet of dolomite, carrying disseminated yellow ore with pyrites.

On the south-east quarter of lot nine and the south-west quarter of lot ten, range six, vitreous sulphuret occurs in chloritic sandstone associated with quartz, felspar and chlorite; masses of pure ore being obtained of from three to twelve pounds weight. On the latter area the Logan mine was located, in which from four to five tons of twenty per cent. ore were obtained.

On lot seven, range eight, two parallel bands of dolomite carrying vitreous sulphuret occur, with a breadth of twenty-three and thirty six feet respectively, separated by about a hundred and seventy-five yards of micaceous and chloritic slates. The ores are intimately associated with veins and strings of quartz, calcspar, chlorite and epidote. A shaft was sunk for sixty feet and a crosscut driven twelve feet across toward the vein to the west but did not reach the ore. On the north-east half of lot six, range nine, a shaft was sunk for one-hundred and forty-two feet in a slate band, carrying similar ore to the last, without satisfactory results, and on the south half of lot four, tenth range, a shaft twenty-two feet deep was sunk in order to cut a band of eighty to ninety paces, in which four cupriferous bands occur. No returns from any of these are available.

Tracing this belt to the north, we have, in Melbourne, several deposits of copper ore, for the most part in green chloritic rocks and micaceous schists. On these deposits three mines have been in operation, viz., the Ryan Hill, the Cold Spring and the Balrath. The first is situated on lot two, range two; the ore is the variegated and vitreous sulphuret in chloritic slates; the size of the band not being stated. At the Cold Spring mine, lot six, range two, some shafting was done, the ore occurring in narrow bands over a considerable breadth, but presumably not in sufficient quantity to be economically valuable. At the Balrath mine, on lot two, range four, the ore, which is of the kind just described, is said to occur in a series of bands, eight in number, ranging from one and a half to five feet in width, in one of which a shaft was sunk, which disclosed some rich bunches of ore. Considerable exploratory work was also done on lot eight, range one, in the shape of pits and trials shafts, on a deposit of yellow sulphuret; the copper being mixed with magnetic and specular iron ore, in a gangue of quartz and calcspar, cutting quarzite and talcose slates. None of these areas appear to have yielded very much copper. In Cleveland, across the St. Francis River, variegated and vitreous ores also occur, with similar chloritic rocks, at a number of places. The only locations worked to any extent, however, were on lot twenty-five, range twelve, at the St. Francis mine, and at the Jackson mine, on the south-west quarter of lot twenty-six of range thirteen. At the former place, in addition to the usual ores already mentioned, green and blue carbonates are said to occur with a little native copper; the whole contained in a lode three feet thick. A shaft was here sunk for 195 feet, and levels and other works driven for 513 feet along the lode, from which a large quantity of ore was taken, which, according to Mr. Bennett, the manager, ranged from six to twenty-six per cent.

At the Jackson mine a shaft was sunk to a depth of twenty feet, the ore being found in a lode of a foot in width, with other larger veins carrying ore in smaller quantity at no great distance. The amount of ore extracted from either of these places is not known.

In Shipton, copper ores are comparatively rare, at least in so far as known, and not in quantity apparently sufficient to warrant mining operations; but in Halifax the variegated and vitreous ores are again quite extensively distributed, the rocks being of the same character of schists as in Melbourne. Mining was carried on at two places, viz., by the Halifax Mining Co., on lot ten of range three, where a considerable mixture of different ores was found in a vein from eight inches to three feet in width, on what is known as the Halifax mine, and visible gold was reported in a quartz vein which was cut. Considerable work was done here by shafts and adits, but no returns as to the amount of ore obtained are to hand, though no large bodies of ore were found. At the Black Lake mine, on lot nine, range nine, some exploratory work was also done by Dr. James Reed and others, but nothing of importance was encountered.

In Chester, although exploratory work was carried on at a number of points, the most important location probably was that in the south-east half of lot eight, range six, known as the Viger mine. Here the ore was principally the yellow-sulphuret in quartz veins, and vitreous ore in the slates. The veins were scattered through a width of 170 feet and were opened at a number of points, from which a considerable quantity of ore was extracted, but involving a large outlay and much work. No deposits of large size were met with, and the explorations, after a very thorough trial, were found to be unprofitable. The metalliferous veins on this property extend across into the adjoining lot, but their size was insufficient to pay for the labor involved in their opening. On lot nineteen, range ten, the Austin Mining Co. made a couple of openings, one on a two-feet vein, the other on one of six feet, but the ores were found to be not sufficiently concentrated in the gangue to pay for extraction. Explorations were also made on lots eleven and fourteen of Craig's Road range, in variegated and vitreous ores in limestones, but without success, as well as on lot five, range six, where a quartz vein from two to four feet thick was observed, which presented some good specimens of ore, but the quantity was too small for successful mining.

Ores similar to the last are found at several points in Inverness, occurring in micaceous, chloritic and nacreous slates or schists, but, in so far as known, no attempt at mining these was made, though one of these localities was among the first recommended for trial in 1847. In Leeds, however, in addition to the great Harvey Hill mine, very fully described in the Geol. Can., 1863, several other deposits were worked, notably, that on the fifteenth lot of the fourteenth range, in close proximity to the Harvey Hill deposit, the ore veins and beds from which were supposed to be continuous in this direction.

The ores are all vitreous, variegated and yellow sulphurets occurring in beds or veins in what have been styled nacreous slates, and, on the lot just mentioned, were owned by the English and Canadian Mining Co. Native gold was found in one of the ore veins. Not far distant from this, to the north-east, in that part of the seigniory of St. Giles known as the Handkerchief, the Chaudière Mining Co. opened up several quartz veins; of which eight were exposed in a breadth of 1,100 feet, two of which had a thickness of two to three feet, and could be traced for 1,200 to 1,500 feet.

About $5,000 were spent in these explorations, but owing to difficulties of various kinds, the work was shortly abandoned. Fine specimens of ore were obtained here, and the quartz is reported by Dr. Reed to have yielded him native and visible gold.

What was regarded as the eastern limit of the second belt was the seigniory of Ste. Mary, where ores similar to those just described occur in red and green slates near ferruginous dolomite, not far from Ste. Mary's Church. From the aspect of the strata, it would, however, almost appear as if this deposit should be more closely related to the red slates and dolomite of the first area. Another mine at St. Sylvester, referred to in the report of the Geol. Survey for 1866, was that of Ste. Margaret. It was opened by the late Thos. Glover, of Quebec, by whom a company was formed in New York, styled the St. Margaret Mining Co. Several shafts were sunk with an expenditure of about $5,000, the amount of ore obtained being about fifty tons. The ore was mostly the variegated sulphuret, the country rock consisting of purple slates, green grits and quartzites. The mine was owned by Mr. Cromwell, but the ore appeared not to be in sufficient quantity for profitable extraction.

The most important of the mines in this section is that so widely known as the Harvey Hill, now the Excelsior, on lot seventeen, range fifteen of Leeds. This location, according to a paper by Mr. Herbert Williams read to the Literary and Historical Society, Quebec, 1865, was the second discovered in the province as carrying copper, the first found having been at Inverness. These discoveries did not appear to awaken very great interest for some time, and Dr. James Douglas seems to be the first who appreciated their value, and through his agency the Megantic Mining Co., was formed for the purpose of exploring and working the copper deposits of Megantic County. Upon the discovery of the Harvey Hill deposit, the location was secured by this gentleman and his associates, who organized a company under the name of the Quebec and St. Francis Mining Co. But little further investigation was however, undertaken by any others than by this company, who explored the Harvey Hill property in such a way as to bring it prominently to the notice of English capitalists, and by these a new company was formed in 1858, under the name of the English and Canadian Mining Co., by whom operations were commenced and carried on with varying success for a number of years. The history of the workings of this celebrated mine for some years is given in the Geol. Can., 1863, with considerable detail. From this we learn that the ores occur in two ways, first as a series of interstratified beds, of which three were clearly recognized, varying in thickness from 6 inches to 6 feet, or possibly more, and second, in quartz lodes or veins, composed of quartz, calcite, pearl-spar and chlorite, some of which carried the variegated and vitreous ores; others carried copper pyrites, in places in very rich pockets. The veins, which sometimes cut across the bedding, were exceedingly rich in certain parts, and in others comparatively barren, so much so that in actual value as a source of supply for copper, the beds were considered the more important. In these the various ores were disseminated through the body of the slates, generally in lenticular masses running with the bedding. These masses were generally small and thin, sometimes having a thickness up to three-fourths of an inch, with a length of six to twelve inches, in addition to scattered grains of the ore through the slate beds; the amount of copper in all being estimated at from three to five per cent.

The hill upon which this mine is situated was pierced by a number of shafts from twelve to forty-five feet deep, as well as by an adit and tunnels; the whole forming a very extensive series of workings. The principal adit was driven into the hill across the measures to a distance of 1,488 feet and intersected the several ore beds, the upper one of which had a thickness, when first worked, of three feet, which, in the lower workings, increased to ten feet and was estimated to carry five per cent. ore. From a prospectus issued by the Consolidated Copper Co., of Canada, limited, in 1872, the subsequent history of this mine is given to that date. The surface works of the company, including much of the plant, were destroyed by fire in 1866 with an estimated loss of £20,000, owing to which operations were suspended till 1870, when Mr. James Douglas, one of the proprietors, took over the work again and resumed operations in the mine. The quantity of ore raised from the commencement of operations in 1858 to the end of 1862 was 322 tons of thirty per cent. copper, in addition to 1,000 tons at the surface of two and a half per cent. and 500 tons of four to five per cent. from the upper bed. The figures as to the output for the different years, as given by Mr. H. Williams, the manager, are as follows:—

	Tons.	Cwts.	Qrs.	Lbs.	
1858.....	9	15	0	2	
1859.....	43	7	0	21	
1860.....	104	5	3	0	Of 30% copper.
1861.....	70	4	1	6	
1862.....	94	17	2	21	
1863.....	113	20	3	14	Of 26% copper.
1864.....	235	12	3	4	Of 20% copper.

The mining ton = 21 cwts., or 2,352 lbs.

The falling off in the value or percentage is attributed to the fact that during the last years the mining was confined principally to the beds and not to the quartz leads. The ore in these beds was found by Mr. Williams, upon careful examination, to occur in lenticular masses, as already stated, varying in thickness from one-sixth of an inch to two or three inches, and in length from three to eighteen and even twenty-four inches. These masses overlapped each other and were disseminated throughout a thickness of five to six feet. This refers to the overlying or upper bed, which appears to be the one principally worked. For 1865 the figures for the output appear to be wanting, but from the report of Mr. Harold Douglas, superintendent of the mine, as given in the prospectus of the Consolidated Co. mentioned, it appears that for a part of 1866, in which year the works were destroyed, 265 fathoms of ore were taken from the bed, dressed to twenty-four per cent. and sold in Liverpool for $35,420, at an average of fifteen shillings per unit. From a paper by James Douglas, jr., of Quebec, in the Lit. and Hist. Soc. of that city, 1870, in discussing the several beds from which the supply of ore had been principally derived, he considers that "there is no likelihood of these beds being of such great extent or of such uniform richness as was at one time attributed to them."

The work of Capt. Williams on the main or upper beds showed that where quartz lodes cut the beds, deposits of ore, often of considerable size and great richness were struck; that the beds gradually became less rich in copper as they were worked away from the lodes which had all along been supposed to derive their supply of ore from the beds with which they were associated; but certain features observed in driving an inclined shaft on a lode, reached from the Kent shaft, induced a change of belief in this respect, the evidence there presented going to show that the beds derived their supply of copper from the lodes by percolation into the contiguous slates, and subsequent operations appear to have confirmed this view.

The most important probably of the different lodes struck in the several shafts is that known as the "Fanny Eliza." This entered the bed near the intersection of the Kent shaft, and on this lode the greatest amount of work appears to have been expended. Where first struck, near the shaft, it was of small size, but rapidly widened as it was opened. Mr. Douglas says of it: "The lode is from twenty to twenty-four inches in width, and very regular, both in dip and strike, which is slightly to the west. The ore, as it comes to the surface yields from eight to twelve per cent. copper. It separates, in crushing, very perfectly from the gangue, and is therefore easily concentrated to form forty to fifty per cent. It consists of a mixture of grey and purple sulphurets. When the lode enters the bed it carries a good deal of yellow and no grey ore, but the yellow entirely disappears in depth. The ore occupies the centre of the lode, whose matrix consists of calcspar, some quartz and a good deal of bitter spar, in the composition of which iron replaces part of the magnesia.

"Tracing the lode upward, but beneath the bed and beyond the spot where it first attracted attention it is seen, in the thirty feet cross cut, as a well-defined lode of about eight inches wide, but carrying very little copper, and has been reached by a level driven upon it from the bottom of Kent's shaft, where, however, it is thin and irregular, though highly charged with copper." From Mr. Douglas' paper we learn, further, that to the east of the Fanny Eliza two lodes enter the bed, on one of which some work was done. The lode runs parallel with the Fanny Eliza, and like it increases in size in the direction

of the dip, but diminishes towards the rise. He says, also, that "the beds gradually decrease in richness in proportion to their distance from the lode." Mr. Douglas also maintains that the Fanny Eliza is a true lode maintaining its width and direction for forty fathoms with a regular dip, and holds that the veins which take their rise in the roof of the bed are also lodes and not lenticular masses. The vicinity of the lodes is indicated by an increase in the richness of the slates and the kind of ore which they carry.

These mines after having been idle for some years, have lately changed hands and are now being worked by the Excelsior Copper Co.

From the notes of Mr. C. W. Willimott, who visited the spot in 1882, we learn that the mine closed work in 1879; operations being confined principally to the Fanny Eliza lode, or vein, and in the level and incline which had been sunk to a distance of 600 feet, some rich pockets of ore had been found. The mines, in 1882, were owned by a New York company, but no work, other than taking the water out of the shaft, was going on. The Excelsior Copper Co., have been carrying on work during the last two years, but have not extended their underground operations to any great distance, having cleared the shafts of water, repaired the timbering and the buildings, and erected a smelter, in which a considerable quantity of the ore lying about had been reduced, the coke for this purpose being obtained from Nova Scotia, the limestone from Dudswell, and the iron from McVeity's mine near Kinnear's Mills, but no returns of output nor of other results are to hand. The present manager is Col. Drew Gay.

On lot sixteen, range fourteen, adjoining the Harvey Hill property to the north, the Leeds Mining Co. began operations in 1863. These were carried on for a couple of years, in anticipation of meeting the extension of the rich lodes and beds of the Harvey Hill mine, but in this their expectations were not realized, since the extension of these beds to this property was not found sufficiently rich in copper to pay for mining. These works were suspended in 1865. They were under the general supervision of Mr. Herbert Williams, and no attempt has since been made to develop the property.

The second range of mines in what was, in 1863, regarded as the eastern portion of the second synclinal, or that area east of the Sutton Mountain ridge, included those of Potton, Durham, Brome, Bolton, Oxford and Brompton. The rocks here, in places, differ markedly from those of the area just described, being very frequently black and other colored slates, with great areas of serpentines and diorites, but the character of the ore is, in some cases, similar to those from the west side of the Sutton ridge, though in certain of the mines some features which are different are presented.

In the township of Potton, the yellow sulphuret is the most abundant ore, the vitreous being rarely found. The rocks here are mostly slates and diorites with serpentines; the copper pyrites are largely mixed with iron pyrite, much of which is the magnetic variety or pyrrohotite. In no case yet observed in this township is the quantity of ore sufficient to warrant any great outlay in exploration, except, possibly, at the recently discovered mine on lot twenty-eight, range nine, on the west side of the Hog's Back Mountain, owned by the Memphramagog Mining Co. This mountain is a mass of diorite, rising to a height of about 800 feet above Lake Memphramagog, and surrounded on both sides by black and bluish grey slates. The deposit of ore, which is principally a pyrrohotite with a small quantity of copper pyrites, occurs on the west side, at the contact of the diorite and slates, in a bed of fifteen to eighteen feet thick, which extends along the side of the mountain for several hundred yards. It dips north west at an angle of about forty degrees, having the diorite for its foot wall, and the surface above the vein and for some distance beyond is covered with a heavy bed of bog iron ore. The ore, in places, contains a considerable quantity of a dark colored or almost black calcite On this vein several pits have been sunk at intervals along a distance of 1,000 feet, and, according to the manager, an inclined shaft has been put down on the vein for eighty-five feet. A cross cut has also been driven with the vein, so as to drain the pits. About 800 tons of the ore have been extracted and piled waiting for shipment. From several assays by Dr. Wyatt, of New York, and by Torrey and Eaton, the ore contains, from different samples:

	Per cent.
Iron	30 to 50
Copper	2.80 to 5
Sulphur	37.75 to 42

A peculiarity of this ore is the readiness with which it spontaneously ignites when piled in heaps exposed to the weather; a feature not common to the ores from most of the other locations.

This mine is situated at 700 feet above the lake, connected by a good road of a mile in length with landing stage, and good facilities for shipment, either to Magog or Newport.

In Bolton, the township adjoining to the north, the extension of the slates and serpentines is found, and mining operations were carried on quite extensively for some years at several points. Probably the most important of these was the celebrated Huntingdon mine, on lot eight, range eight, and the Ives mine, a couple of miles further north, on lot two, range nine, and lot four, range eight.

In the former, the ores are mostly copper pyrites, mixed with the magnetic pyrites or pyrrohotite, a large deposit of which occurs in chloritic slates in contact with serpentine and diorites. A band of more than three feet of solid granular copper ore occurs near the serpentines of the west side of the veins. A section of the metalliferous portion, going eastward from the western wall of serpentine is as follows:—

	Feet.
*1. Greenish diorites with disseminated masses of copper pyrites and magnetic iron pyrites	2·0
2. Compact granular copper and iron pyrites with disseminated masses of quartz	1·4
3. Magnetic iron pyrites, interstratified with thin leaves of chloritic and mica schist	0·9
4. Greenish diorite with disseminated copper and iron pyrites	1·0
5. Compact granular iron pyrites, with dissemi-nated small masses of quartz	2·6
6. Green chloritic slate, with disseminated masses of copper pyrites, mingled with iron pyrites	8·0

Work was begun on this property in August, 1865. From notes kindly furnished me by Capt. W. Warne, the present manager of the Memphramagog Mining Company's works, the management was in the hands of Capt. Bennett, of Lennoxville, who controlled operations till 1870-71, when the mine was sold to a Glasgow company and the name changed to the Huntington Copper and Sulphur Company, under the management of Mr. John Rudda of Cornwall. The output under the old company's management is stated to have been from 200 to 300 tons of ten per cent. ore per month, part of which was shipped to England and part to the United States. Extensive buildings, etc., were erected, and under Capt. Rudda's management, the output was increased to from 400 to 500 tons per month of seven per cent ore.

In 1872, works were erected for carrying on the Longmaid or Henderson process, by which the ore was burnt in retorts to drive off the sulphur, but the process did not apparently meet with much success. The ore was then crushed, mixed with common salt, and calcined in furnaces and placed in vats with hot water and acid from the tower, and run off into other vats containing scrap iron, by which the copper was precipitated. Hundreds of tons of precipitate, containing 65 to 75 per cent. of copper, are said to have been made in this way.

In 1873, the works were destroyed by fire, with a loss of $75,000.

They were partially re-built, and mining was carried on in a desultory fashion for several years, and the company finally closed operations in 1883. During the past year the property has passed into the hands of Messrs. G. H. Nichols & Co., of Capelton. In the working of this mine, two deep shafts were sunk, one to the depth of between 500 and 600 feet, called the Huntingdon shaft, the other known as the Wright shaft, 200 feet deep. North of the Huntingdon mine on lot six, range eight, were the works of the Canadian mine, presumably on an extension of the vein just described. Two shafts were here sunk, one to a depth of 100 feet, the other 50 feet, and some ore shipped to Capelton. The mine subsequently passed into the hands of the Eastern Townships Bank, and has not been worked for some years. Further north, on lot two, range nine, Bolton, the Ives mine was situated. Two shafts were here sunk the Ferrier and the Galt, the former to a depth of about 60 feet, the latter for 100 feet. This mine was opened in 1866, and worked for ten years, and a large quantity of from 10 to 14 per cent. ore was extracted and shipped to England. These three mines are situated on the east side of the Missisquoi River, south of what is now known as Eastman, and are all probably located on the same belt of ore.

The serpentine rock is found at all these mines, with slates of various colors, differing, in this respect, from the rocks of the second area, or that west of the Sutton Mountain. Very favorable reports on these deposits have appeared by Dr. T. Sterry Hunt and others, but the presence of the magnetic pyrites serves to distinguish the ores as a class from those already described.

The copper deposits of Orford Township were mined at several points. On lot nine, range A, yellow sulphuret occurs in a dioritic rock, near serpentine, of which six veins are found in twenty-five feet. This was exploited by Messrs. McLeod and others. On the third lot of range F, and on the eighth lot of the same range, similar ores, with a like association of rock matter, were found, but at none of these does systematic mining seem to have been carried on.

At the King mine, on the third lot, range thirteen, variegated ore, associated with magnetic oxide of iron, occurs in a four-foot band of dolomite and serpentine; and on the west side of Brompton Lake, on the east side of a high hill, called the Carbuncle, composed of diorite and serpentine, several small openings were made, from which in all about twelve tons of twelve per cent. ore are said to have been obtained. The difficulties of working this deposit, from its comparative inaccessibility, must have been very great, and the quantity of ore in the rock appears at present very limited, although a five foot vein of solid yellow sulphuret is reported to occur there. This mine was styled the Carbuncle Hill mine, and was located in the second lot of the fourteenth range of Orford. In the township of Brompton the only mine worked was on lots twenty-eight and twenty-nine of range nine, where the ores, which were of the variegated and vitreous varieties, were found in serpentine. According to Mr. Chas. Robb, the principal deposit was in a five foot vein, containing, according to his report a promising quantity of ore. It has, however, long since been abandoned.

(To be continued.)

*Geol. Rep., 1866, p. 35.

Annual General Meeting and Dinner of the Gold Miners' Association of Nova Scotia. Important Amendments to the Mining Law Discussed.

The Annual General Meeting of the Gold Miners' Association of Nova Scotia was held in the Halifax Hotel, Halifax, on Tuesday afternoon, the 10th instant, Mr. J. M. Reid, of the Oxford Gold Mining Co., Musquodoboit Harbor, in the chair. The following office bearers were elected for the ensuing year: President, Mr. J. M. Reid, Musquodoboit Harbor; Vice-President, H. T. Harding, Truro, N.S.; Secretary, H. M. Wylde, Halifax; Executive Council, John E. Hardman, S. B. Oldham, B. C. Wilson, Waverley; George Stuart, Truro. The following were elected honorary members: Sir William Dawson, Montreal; Mr. H. S. Poole, F.G.S., Stellarton; Prof. H. T. Hynd, Windsor; Hugh Fletcher, B.A., Ottawa; E. R. Faribault, C.E., Ottawa.

Mr. B. C. Wilson, Waverley, chairman of the committee on mining laws, read his report, in which were embodied the following suggested amendments to Chap. 7, Revised Statutes of Nova Scotia.

SECTION 2.—Amended by striking out the 2nd, 3rd and 4th lines as far as "afternoon," and substituting therefor, "at ten a.m. and closed at four p.m., time of the 60th meridian, except on Saturdays, when it shall be closed at one p.m.

SECTION 5.—Amended by striking out these words in 5th and 6th lines, "from time to time as may be deemed necessary," and by inserting after the word "inspect" in 6th line, the words "at least annually."

SECTION 6.—Amended by striking out "shall not" in 6th line, and by inserting after the word "and" in the 6th line, the following, "and they shall not, nor shall Mining Surveyors nor any employee of the Mines Department, be directly or," &c.

SECTION 10.—Amended in the first line so as to read, "all mines of gold, or of gold and silver, shall," &c., &c.

SECTION 11.—Amended to read, "areas shall be laid out, as far as possible, uniformly and in quadilateral and rectangular shapes. Surface measurements of areas shall be horizontal, and each area shall be bounded by vertical planes passing through the horizontal surface lines."

SECTION 12.—To be repealed.

SECTION 13.—Amended by inserting after the words "full" in the 8th and 12th lines respectively, the words "*with their address*."

SECTION 14.—Amended by adding after the word "number" in the 4th line, "he shall also mark upon said plans all grants of land in which the mineral right has been granted with the fee."

SECTION 17.—Amended by adding the following to the section, "and the date of every such lease shall be the date of the application for said lease, and no other date shall appear *within* the lease, but the date of registration may appear upon the outside or cover of the lease."

SECTION 27.—Amended by striking out the whole of the first line and substituting the following: "All leases shall be in perpetuity provided the yearly rental is paid thereon, and provided also that all the covenants of the lease are kept and fulfilled, but," &c. Also by adding to end of section, "nor shall such lessee be entitled to any priority in applying for a new lease."

SECTION 73.—Amended, by inserting after the word "chapter," the following: "Or the lease thereof shall have lapsed and expired or terminated, and also in the case of simultaneous applications for leases on vacant ground, by two or more applicants."

The following new sections to be added:—

SECTION —.The Commissioner of Mines shall also cause to be established, within three months after application for the same by any lessee or licensee, in all proclaimed districts and also all unproclaimed districts where at least 100 areas have been applied for, a *base line* of not less than four hundred and fifty feet in length to be laid off along the course of the lodes as nearly as may be practicable. Such *base line* shall be marked at its two ends or termini by substantial, permanent and accessible monuments of stone or iron, with bench marks cut thereon or affixed thereto, and all areas shall be laid off from this *base line* by lines parallel to the same or at right angles to it, or its course prolonged; and any person removing, altering, obliterating or defacing such monument or monuments, or any mark thereon, shall forfeit a sum of not less than one hundred nor more than five hundred dollars for each offence, to be recovered in the name of the Commissioner in the same manner as an ordinary debt.

SECTION —.—No lessee shall mine within ten feet of the boundary line of his lease or on any vein or lode found therein, but he shall leave a barrier of unwrought country-rock of at least ten feet in thickness between his workings and his boundary; and no opening shall be made in this barrier without the consent in writing of the lessee of the

adjoining area or areas, under penalty of not more than one thousand dollars nor less than one hundred dollars for each offence, to be sued for in the name of the Commissioner; and the party injured by such unlawful working or mining shall have an action at law, in addition to the penalty, against the offender for all damages incurred by or consequent upon such unlawful working or mining.

SECTION —.—In all sales of mines of gold or of gold and silver involving change of ownership, either in whole or in part, a transfer as now executed and recorded shall be conclusive evidence of such sale or change of ownership, and the Commissioner shall also affix to the lease or leases of such transferred areas a certificate under his seal, setting forth the fact of transfer and the names of the purchaser or purchasers, and he shall charge a fee of one dollar for each and every certificate so affixed.

In cases where the holder of any lease shall sell any certain number of areas less than the whole number of areas contained in such lease, and shall retain the balance of said areas himself, the several portions thus becoming separate and distinct properties, it shall then be the duty of the Commissioner, upon presentation of the original lease, to issue new leases in the names of the new owners, which new leases shall bear date corresponding to the original lease and which shall have, acquire and hold all the conditions and privileges of the original lease; and for each lease thus substituted the Commissioner shall charge a fee of $1, but no rental charge of $2 per area shall be made as in the case of an application for a lease.

On the motion of Mr. John E. Hardman it was resolved: That the report of this Committee be confirmed as the sense of the Gold Miners' Association of Nova Scotia; that it be committed to the Executive Council of the Association with instructions to present same to the Government and House Committee on Mines and Minerals, and to secure amendments to the Mines Act as far as they may be able. The meeting then adjourned.

The annual dinner of the Gold Miners' Association of Nova Scotia took place on Wednesday evening, March 11th, 1891, at the Halifax Hotel, and was attended by a large number of the members of the Association and their friends. The chair was occupied by the President, Mr. J. M. Reid, of the Oxford Gold Mining Company, Musquodoboit Harbor. On his left sat Hon. W. G. Frye, Consul General of the United States, and on his right was Hon. W. S. Fielding, Provincial Secretary. Among the other guests were Hon. J. W. Longley, Attorney-General of Nova Scotia, Prof. J. G. MacGregor, of Dalhousie University, Mr. H. S. Poole, F. G. S., manager of the Acadia Coal Co., Stellarton, Mr. S. M. Brookfield, Mr. C. J. Wylde and others. After partaking of a most excellent *menu* served by Messrs. Hesslein & Sons, the chairman called the company to order and proposed as the first toast of the evening, "The Queen," the whole company in response singing the National Anthem. The next toast proposed by the chairman was, "The President of the United States."

HON. W. G. FRYE, Consul General of the United States, responded. He thanked the Association for the hearty manner in which the toast had been received, and was exceedingly glad to be present at this merry gathering. He felt obliged to confess that what he did not know about mining matters would fill the biggest library that has ever been seen, but he could say truly that he was becoming deeply interested in the question of gold mining in Nova Scotia. In making his official reports on the resources of the province, he had not failed to observe from year to year the progress which had been made in gold mining. (Applause). He remembered the extent of the output in 1882, which was the first year he had spent in Nova Scotia, and when some time afterwards he left his official position here for certain reasons which it would be quite unnecessary to dilate upon (laughter), he took away on that vacation very strong impressions of the value of the gold mining industry of the province, and on his return to Nova Scotia again these impressions were further strengthened, because he soon became aware that the development of that great industry had gone on increasing (hear hear), and in the last report which he had made he stated that gold mining in Nova Scotia was one of the staple and substantial industries of the province. (Applause). He had not heard of any great bonanza in connection with any of the gold mines of the province, but from his own observations he was in a position to testify that gold mining was one of the really prominent industries of Nova Scotia. He remembered seeing some years ago in the *Chronicle* office of this city some slabs of gold quartz with the gold sticking out of them like a sore finger, so to speak. (Laughter). He was glad to meet so many miners, and could assure them that he watched the progress of the mining industry with great interest, and if there was anything which he could do in any way to promote their interests he would be only too glad to undertake it. (Applause). He sincerely wished that friendly relations would always exist between this country and his own, and furthermore, he could not help adding, without desiring to introduce political questions into this matter, that he hoped the governments of the two countries would agree to some trade arrangement whereby the people on both sides of the line could be better accommodated than they are now (applause), and secure freer and better relations as to business and friendly intercourse between the people of the two countries. (Applause). It was evident from the language adopted by a portion of the Nova Scotia press that some Nova Scotians did not understand the position of the United States people, and perhaps he might concede that there were some persons in the United States that did not really understand the people this country. It was evident that in some sections of this province a certain prejudice existed against Americans. It reminded him of the prejudice which used to exist between the North and South in his own country. A young fellow from Kentucky happened to visit Washington for a few days. He was a good young man, but had not travelled much, and had somewhat vague ideas as to some of his countrymen. He met a few friends from his own district who were then at Washington, but he did not meet many others on his trip. On his return home he was asked who he had seen at Washington, and he replied: "Well, there was a delegation from Kentucky, and a few people from Virginia, and there was a gentleman from Maryland and another gentleman from Ohio, and a fellow from New York (laughter) and a son of a gun from Massachusetts." (Laughter). Perhaps if a certain type of Canadian were reporting the addresses here to-night, and was subsequently asked who was here he might say: "Well, there were several gentlemen from Nova Scotia, and a few gentlemen from New Brunswick and a gentleman from Ottawa, and lastly, a son of a gun from the United States." (Laughter). It was a great pity that the people of the two countries did not know each other better, because with better knowledge and closer intimacy all prejudices would disappear. Personally he was profoundly interested in the progress of the gold mining industry in Nova Scotia, and he hoped sincerely that the members of the association would prosper, and always strike it very rich. (Applause).

The Chairman next proposed as a toast:—"The continued prosperity of our Fair Province," and coupled with the toast the name of Hon. W. S. Fielding, Provincial Secretary of Nova Scotia.

HON. MR. FIELDING said that he felt bound to acknowledge the fact that in the gold mining industry, as in many other industries in Nova Scotia, the Province was indebted in a very large degree to American capital and American enterprise. (Applause.) It was a pleasure to know that our neighbors across the border were not indifferent to the resources of Nova Scotia, and he sincerely desired that they might find profitable investments for their capital in this province. Nova Scotia had immense resources which if properly developed could not fail to make the province a very rich and prosperous country. Although this province was not pre-eminently an agricultural country, it should not be forgotten that there are in Nova Scotia agricultural sections wich will compare favorably with any portion of North America. He need only refer to the fertile valley of Annapolis, the valley of Margaree and the splendid stretches of land in the Musquodoboit Valley. In the matter of mines Nova Scotia was pre-eminently rich. In regard to the coal mining industry, represented at this gathering by his friend Mr. Poole, the province had good reason to boast of the progress which had been made in the development of that industry. As to the iron mines of the province it seemed as if we were just beginning to properly appreciate their enormous value, and he believed that the day was not far distant when Nova Scotia would take first rank as one of the iron producing portions of the continent. (Applause.) In reference to gold mining, that enterprise used to be regarded as having a decidedly speculative element in it, but there was ample reason now to rejoice that the pursuit of gold mining had ceased to be highly speculative, and had settled down and become one of the solid and substantial industries of the province. (Applause.) From the very nature of the enterprise there would always be more or less of a speculative character in it, but, as his audience knew, there were a large number of instances in which gentlemen engaged in gold mining, in this province, had in recent years made large sums of money, not by the selling of gold mines, but by the working of gold mines and by honest industry and perseverance. (Applause.) We hope to be able to show the people of this continent and the people of Europe, that gold mining is an honest and legitimate enterprise, and affords as fair a return for investment as can be had in any part of the world. (Applause.) In addition to other valuable resources, Nova Scotia could proudly boast of her great fisheries. There was no coast line so rich as the coast line of Nova Scotia. Our province possessed great wealth in her soil, her forests, her mines and her fisheries, and all that was required was a population of enterprising, intelligent and progressive people, having faith in the resources of the province. With such a population the future of Nova Scotia would be a bright and prosperous one. He had listened with pleasure to the remarks of the United States Consul. Why was it that on occasions like this a toast was always offered to the President of the United States? Why do we not toast the Emperor of Germany, the President of France, or the King of Spain? They are all foreign countries. But many of us recognize that the neighboring Republic is not absolutely a foreign country, but that these neighbors of ours are bone of our bone and flesh of our flesh, speaking the same language and possessing the same glorious traditions, and our desire should be to draw them near to us and to encourage a feeling of neighborliness and amity. While we desire to retain our allegiance to our old flag, and they retain their allegiance to their own, we yet should desire to live in friendship, and to cultivate harmonious relations, in the fullest confidence that with such relations we shall bring about our prosperity and their prosperity, and promote the happiness of that great race to which we all belong. (Cheers.)

THE VICE-CHAIRMAN, MR. B. C. WILSON, in rising to propose the next toast, dwelt humorously on the tenacious character of the disease called gold fever which so many of the audience were suffering from. A person once contracting this fever was rarely cured afterwards. It was not intermittent in its character, and although a sufferer might imagine that he was actually convalescent, and had really shaken off the complaint, and could look upon the gold when it was yellow, the fever was bound to break out again at certain seasons of the year. (Laughter.) The newspapers had lately been filled with statements about loyalty. There was an intimate association between loyalty and "royalty," and it was clear that gold miners who were committed to "royalty" must necessarily be devoted to loyalty. (Laughter.) The gold miner was so far committed to royalty that he contributed two per cent. of his profits to royalty, and for that reason could claim that he manifested a fair per cent. of loyalty. (Laughter.) Without any further observations he proposed as a toast "The success of the mining industries of Nova Scotia," and coupled with the toast the name of Mr. H. S. Poole.

MR. H. S. POOLE, in responding to the toast, said that the ordinary avocation of a miner was calculated to make him cautious before he acts, and should also have the effect of making him cautious before he speaks. He himself was naturally of that disposition, and when he first received the honor of an invitation to this gathering, he hesitated about leaving the quiet life he was leading in the grimy neighborhood of the mines to accept the invitation. He almost felt inclined to think when he first received the invitation that the Association might desire some countenance with lugubrious aspect to sit at the funeral meats of some legislation that had gone amiss. (Laughter.) He knew that on a previous occasion there had been presented a bill of fare which required the digestion of glycerine, and as he came from a neighborhood where King's Cordial was prepared, he might be considered in a position to discourse as to the efficiency of that cordial. (Laughter.) The industry with which he was directly connected was not the gold mining industry, but the coal industry, nevertheless he could say that coal managers took a lively interest in the progress of the gold miners' enterprise, as the more gold that was produced the more the coal owners were ready to receive. (Laughter.) The carrying on of coal mining was extremely hazardous and attended by constant risks, and of course there was not much opportunity for those engaged in it to develop much literary and oratorical ability. There was still living, however, a man in England called the pitman poet, a Mr. Skipsey, and some lines written by that remarkable man might appropriately apply to the recent disaster which had occurred at the Springhill mines, and which had caused such widespread bereavement and sorrow. The poem in question was entitled "Get Up," and was written at a period when the miners were obliged to begin work at a very early hour each day.

> "Get up, the collier calls—get up;
> And in the dead of night
> I rise a weary wight,
> I take my bite and sup,
> My mining clothes I don,
> My birds I kiss,
> And then I whistle as I shut the door
> I may not ope again." (Applause.)

MR. J. E. HARDMAN rose to propose the next toast and said: It is well known that the pursuit of gold mining required as essential qualities, sound discipline, keen observation and inflexible endurance. The occupation of a gold miner was continually beset with difficulties which often made them wish that they knew a little more. Gold miners could not have too much education. Nova Scotia was a glorious province, and the Hon. Premier had properly and eloquently extolled its magnificent resources. But more active development of these resources was absolutely necessary. In gold mining, instead of an output of half a million dollars a year, we should produce five millions annually. (Applause.) In this province the people were dependent on foreign capital to some extent for the development of their mineral wealth, but the people of Nova Scotia should not be dependent on foreign capital at all. There was enough hidden wealth in Nova Scotia to place the province ahead of any other portion of the continent if her resources were only fully developed. (Applause.) Proper technical training and education were the great factors in successful mining operations, and he wished now to propose as a toast "The Science Teachers and Educationists of our Province."

PROF. J. G. MACGREGOR of Dalhousie University, in responding, said that he was gratified at having the opportunity of dining with the Gold Miners' Asssociation. He presumed that he was honored with an invitation to this pleasant and interesting gathering because he represented an institution of science. With regard to that Institute he could truly say that the Gold Mining Association had its best wishes and its warmest sympathy, and that a great portion of the efforts of the Nova Scotia Institute of Science were directed to investigations concernir the development and fostering of the gold mining industry in this Province. (Applause.) Very recently the Institute had taken a step which he believed would meet with the approbation of all the members of this Association. As was well known the Geological Survey had been doing excellent geological and topographical work in Cape Breton, the scale of a mile to an inch having been adopted there. At present the surveys in Antigonish and Pictou Counties had been completed admirably and a very large amount of detailed information had been obtained. With regard to these Counties it was proposed that the scale should be reduced from one mile to the inch to a scale of four miles to the inch, and in many cases a map of that description would not adequately represent the amount of work done, As it was of the utmost importance that these maps should embody all the information we possessed, and should present any new information that might be obtained, the Institute of Science had agreed to petition the Dominion

Government to continue the publication of the maps on the scale of one mile to the inch, and use throughout Nova Scotia the same scale as had been adopted in Cape Breton. (Loud applause). He suggested that the Gold Miners' Association should endorse the step taken by the Institute of Science, so that all these maps would be published in such a form as would be most useful to the mining interests of the country. (A voice—"We have already done so," and applause). No one was more ready than he to welcome visitors to this Province from the United States, but he would like to feel that in regard to the mining industries of the Province we were doing more for ourselves and were not so dependent upon our friends on the other side of the border. (Applause.) Very few of those Nova Scotians who were doing good work in mining operations in this Province owed their success to training received in the schools or colleges of this country, but he thought he could say that those gentlemen who have come from the other side of the border owe their success to the training and knowledge which they had received in the technical educational institutions which flourished in the United States. The question therefore might properly be asked: Were the school teachers and science teachers in Nova Scotia doing their duty, and were the citizens doing their duty in this regard? He had lately been endeavoring to find out the men in this province who should have a special knowledge of geology and mineralogy, and he had been surprised to find how few men there were here who had special knowledge of these important subjects. In other countries numbers of men in cities and towns could be found who had their interests in these subjects stimulated by a special course of scientific training, and who, although in after life devoting themselves to other avocations, have nevertheless maintained a lively interest in these studies. In the Nova Scotia schools there was no adequate teaching of science. There were no endowments essential to the proper carrying out of technical studies of this kind. It was impossible for our school teachers as a general rule to be well versed on these matters under the circumstances, and even our colleges were behind-hand. Some of the professors were sacrificing their whole lives in order to do all they could to promote these studies, and instead of teaching one or two branches have now consented to teach five or six important branches. He was inclined to think that these gentlemen would do far better for themselves if they were to restrict themselves to one or two subjects, but in the interests of their scholars they grapple with five or six branches. A great many people expected that Dalhousie College should do a great deal in this direction, because of the endowments she possessed; but it should not be forgotten that these endowments were tied up, and were intended to be devoted only to the teaching of particular subjects. In the United States, 15 or 20 years ago, there was no institution where a student could have gone to perfect himself in these technical branches; but now if a student applied to him for advice as to where to perfect himself in these branches he would send them to the United States. In that great country enormous progress had been made in that respect, and the people had thoroughly recognized the vast importance of the study of science. There were two prominent members of the Nova Scotia Government present this evening, and he felt assured that if the people of the country showed that they appreciated the necessity for further advancement in the study of science the Government would be prepared to act upon any reasonable suggestion emanating from any portion of the people. If the Gold Miners' Association would assist the Institute of Science and others in spreading throughout Nova Scotia the absolute necessity of more scientific training they would be doing an admirable amount of good for the whole province. (Applause). Although the authorities at Dalhousie College felt their hands somewhat tied by the restrictive character of their endowments they had nevertheless determined to assume extra work, and had recently resolved to try what could be done to start a technical department. (Applause.) At present there was a science course in which the student received a training in pure science, but the authorities of the college had lately determined to remodel that course, so that it should be much wider in its range, and leading engineers in Halifax had intimated their willingness to second our efforts in that respect. (Applause). These assurances enabled the authorities of the college to announce that they would be able during the next year to offer to the young men of Nova Scotia a course not only in pure science, embracing geology and chemistry, but also a course in civil engineering mining engineering, and possibly metallurgy. If the student would in addition spend his summer in the workshop, or with an engineer, he would thus obtain all the elements of a thorough training. A strong effort should be made to spread throughout the community the conviction that a more thoroughly scientific training is essential, and the Gold Miners' Association would be rendering a valuable service to the province by spreading such ideas far and wide. (Applause.)

Mr. McDuff proposed the toast of the Press, which was responded to by Mr. C. F. Fraser of the *Critic*, Mr. J. M. Geddert of the *Chronicle*, and Mr. B. T. A. Bell of the REVIEW. Mr. Fraser in the course of a very forcible and eloquent address, said that in regard to gold mining in this province he believed that we had but scratched the surface, and that ultimately the great second pay streak would be found in this province. (Applause.) He considered that the government should offer a bonus to the man who strikes the second pay streak. (Hear, hear.) A proper assay was badly needed in the province, and its establishment would be of immense benefit to all those engaged in the gold mining industry. The Press of this province should by its influence, and constant utterances, seek to convince the people of this country of the immense wealth that is lying at their doors, and in succeeding in making the people appreciate the enormous mineral wealth of the province, the press will have accomplished a great duty pregnant with enduring service to the country.

Mr. B. T. A. Bell proposed the health of the guests of the Association, and coupled with the toast the name of Hon. Attorney-General Longley.

Hon. Mr. Longley replied in an extremely witty speech. Brief, but very pleasant speeches were also made by Mr. Jas. Eisenhauer, ex-M.P., for Lunenburg county, and Mr. S. M. Brookfield.

Mr. C. F. Fraser proposed the health of the Gold Miners' Association, which was suitably responded to in a few graceful remarks from the President, Mr. J. M. Reid.

The toast of the Bar was responded to by Mr. W. B. Wallace and Mr. H. M. Wylde, and Mr. Willis eloquently replied to the toast of the Ladies.

The very pleasant proceedings terminated by the whole gathering singing Auld Lang Syne.

Low Grade Ores and Electric Transmission of Power.*

By James Brady, C.E., M.E., Victoria, B.C.

GOLD QUARTZ.

Two dollar auriferous quartz, when found in large veins or lodes, can now be mined and milled in California at a profit. When this branch of mining was first entered upon in that State, fifty dollars per ton gold quartz was about as low grade as could be mined and milled profitably, and thirty dollar rock was thrown aside. This was owing to the cost of labor and the other factors of production, imperfect machinery and methods, and profound ignorance of the business. Managers and superintendents were without knowledge, practical or technical, and the mining and metallurgical engineers brought from abroad, were years in learning to adapt themselves and their methods to the widely different circumstances that prevailed here. Failures were the rule, and for many years idle quartz mills and abandoned mines were to be seen all over California. This was not due to the poverty of the mines, but to the circumstances above enumerated, and hundreds of quartz mines, abandoned in early days, have been re-opened within the last five years or so and, with improved machinery and under competent management, are paying large dividends: and gold mining is today as safe and profitable a business as farming, fruit growing, commerce or any other pursuit in California.

SILVER ORES.

The same remarks apply to silver and silver bearing base metal mines. Owing to the great improvements in mining, milling, concentrating and smelting machinery and plant, the application of electricity to the transmission of power, and the increased knowledge possessed by our mining engineers, superintendents, foremen and men, of the proper methods of mining and beneficiating the ores, it is a fact that concentrating ores of the above character, yielding an average of only $5 per ton in value of silver and base metal combined, can be mined and reduced on a large scale, at a fair profit, in localities where water power can be had, and where water or railroad transportation can be reached within a few miles, and $10 silver bearing concentrating rock will pay almost anywhere that machinery can be brought in to work it, provided the vein is large (say over 10 feet wide) and can furnish from 100 tons upwards per day of such ore.

GOLD QUARTZ MILL, AND MILLING.

The modern gold mill is usually built in such a situation that the ore can be delivered by car or waggon at the upper part, where it is dumped against an inclined "grizzly," and the finer ore, passing through the interstices of the grizzly, falls directly into the main ore bin. The coarser ore (too large to pass through the grizzly) is screened off by gravitation into the coarse ore bin, from which it is drawn, by gravity, directly into the rock breakers or it falls upon a floor in front of the rock breakers; by these it is crushed and falls into the main ore bins.

From the main ore bins the ore passes through gates into the "self-feeders" which supply it automatically to the batteries. Quicksilver is fed at intervals to the mortars of the battery, and coming in contact with the native or "free" gold of the finely crushed ore, forms with it an amalgam. This amalgam is caught partly by the copper plates in the battery, and partly upon the amalgamated, or silver plated copper plates on the apron and in the sluice boxes outside, after it has issued through the screens of the mortar. The amalgam is "cleaned up" periodically and retorted. Retorting consists in the sublimation of the quicksilver, the vapours of which are condensed in water and the quicksilver collected; the residual gold is in a porous state; it is melted with fluxes in crucibles and cast in ingots. The pulp from which the free gold has been extracted by amalgamation passes over concentrators of various mechanical devices; these concentrators effect a separation of the auriferous sulphurets from the worthless gangue. In California the concentrated sulphurets are treated by the chlorination process. In some other sections of the country the sulphurets are sold to the smelting works.

* Paper read before the Annual Meeting of the Provincial and Dominion Land Surveyors, Ottawa, February, 1891.

AURIFEROUS SULPHURETS.

The gold ores of California carry, on an average, 2% of sulphurets. The concentrated sulphurets assay on an average from $60 to $90 per ton in gold, with from a trace to several dollars in silver. The Custom chlorination works in California charge $20 per ton of sulphurets (about 40 cents per ton of quartz before concentration) for treatment, and return 90% of the assay value. Under conditions ordinarily favorable, a plant treating 6 to 9 tons per 24 hours, can reduce the sulphurets at a cost of $8 to $10 per ton, extracting 90 to 94 per cent. of the assay value of the gold.

SILVER MILLING ORES, FREE AND REBELLIOUS.

Silver milling ores are either "free" or "base," and the latter require a preliminary or chloridizing roasting. The free milling ore passes through the same process as gold ores until the battery is reached. The ores are crushed wet in the battery, but battery amalgamation is not practiced. From the battery the pulp passes through sluices into settling tanks where the superfluous water is drained off. The pulp is then shoveled into the pans where salt and bluestone or other "chemicals" are used. Here the ore is first ground and then amalgamated. After several hours the pulp is run into settlers where it is diluted with water, and the heavy amalgam and quicksilver settles to the bottom; this is then collected and strained and the dry amalgam retorted.

Base or rebellious silver milling ores contain too much sulphur, arsenic, antimony, etc., to be treated by free milling process. After crushing in a rock breaker, they require a previous chloridizing roasting to adapt them to the pan-amalgamation. They are dried before the stamping and then stamped dry. The mortars have double discharge. The pulverized ore discharged through the screens of the mortars is carried by conveyers to elevators which lift it to the furnace floor. There are several types of furnaces in use, notably the Buckner, the White & Howell, the Stetefeldt, the O'Hara and the ordinary reverberatory furnace. The time of adding salt depends on the mineralogical character of the ore. When there is much arsenic or antimony present, salt is economized by a preliminary oxidizing roasting of the ore. The salt is crushed either separately or with the ore. It should be thoroughly incorporated with the pulp. To obtain a high degree of chloridation, sufficient sulphur must be present to effectually liberate the chlorine of the salt. Calcspar, braunspar, and fluorspar, etc., retard the chloridation by absorbing a large part of the sulphuric acid produced. Minerals containing arsenic, antimony, tellurium, selenium, etc., increase the loss of silver arising from volatilization. Zinchlende requires long roasting to convert it into sulphate. The subsequent process of amalgamation is similar to that described with reference to the treatment of free-milling ores, though the grinding process is usually omitted or curtailed in the pan-amalgamation of roasted ores.

CONCENTRATION.

A modern concentrating mill encloses a good many forms of machinery by which ores are prepared for subsequent metallurgical treatment. The operation of concentration and dressing is based on the difference of specific gravity of the mineral constituents of an ore, by virtue of which the minerals have unlike velocities in falling through water or other medium. Water is preferably the separating medium. The coarse crushing of the ore is done by rock breakers, and the "screenings" or coarse stock from the rock breakers is further comminuted by rolls or stamps. But for this purpose rolls are preferable, inasmuch as their use minimizes the amount of slimes incident to crushing.

From the rolls the ore passes into the first (largest and coarsest), of the series of five revolving screens or "trommels." The trommels are either cylindrical or conical in form. In the former class the conveyance of the "screenings" from the delivery end to the discharge end of the trommel is effected by the inclination given to the axis of the trommel. In the latter class this is attained by virtue of the conical shape of the trommels, the screenings drop through "spouts" into the jigs, which have sieves corresponding in mesh to those of the delivering trommels. The trommels have sheet iron receiving aprons into which the ore falls after passing through the perforations of the screens. Through these aprons the ore is delivered to the next finer sieved trommel of the series.

The ordinary type of jig is a trough-shaped water box divided into two compartments by a partition extending part way down. In one of the compartments is a loosely working plunger operated reciprocally. In the other compartment is a fixed horizontal screen on which the sized ore is fed.

The strokes of the plunger cause a pulsation of water through the sieve. The ascendant current raises the mixed particles, which, in their descent through the water, arrange themselves in layers.

The sorting of the "equal falling" minerals takes place in a series of inverted pyramidal boxes called "Spitzkasen." Water is brought to each compartment from above by a pipe, which; discharging the water downward against the bottom of the box, produces an ascending current. This ascending current prevents the deposition of the lighter particles, which are consequently carried over into the next box of the series. These boxes are so arranged as to cause a slowly flowing current throughout the series.

Where the system of hydraulic classification is more extended, series of boxes is used under proper conditions as to size, velocity of current produced, &c., for the

separation of the sands. From these boxes the slimes retained in the current go to the slime classificators.

When jigging is not practicable, on account of the extreme fineness of the slimes, the pulp is worked on round tables, buddles, percussion tables, Triumph & True Vanners, &c. A sizing is effected by these machines. The largest particles (specifically lighter), being acted upon more readily by the flowing water, are carried down the inclined planes and pass away as tailings, while the smaller (specifically heavier) particles remain as concentrates.

SMELTING.

Argentiferous lead, and other base ores, concentrated and unconcentrated, are smelted in water jacket blast furnaces of from 30 to 60 tons capacity per day of 24 hours, with reverberatory furnaces for roasting or matting refractory ores. The fuel used is charcoal or coke, or a mixture of both. The consumption of charcoal, when used alone, is from 20% to 25% of the weight of the smelting mixture, and that of mixed fuel from 15% to 20%. The waste in charcoal amounts to about 12½%. One cord of ordinary pine will make from 400 lbs. to 450 lbs. of charcoal. The fluxes commonly required are silica (quartz, sandstone, &c.), limestone and iron ore. Some ores have to be roasted and melted into a matte in a reverberatory furnace, before being smelted in the blast furnace, while others, such as carbonates of lead, and lead ores associated with a sufficient amount of oxide of iron, &c., can be smelted without flux or preliminary roasting and matting. When ores are obtained from many different mines, combinations can be made that will require no foreign flux.

Under the most favorable conditions as to ore, fluxes, fuel and labor, the most docile ores may be smelted for from $3.00 to $4.00 per ton; but under unfavorable conditions may run as high as $18.00 or $20.00 per ton.

WATER POWER.

The Treadwell Mine, Douglas Island, Alaska, is said to have the largest quartz mill in the world. All the machinery, consisting of 240 stamps, 96 concentrators, 12 ore crushers, &c., requiring about 500 horse power, is run by a single wheel seven feet in diameter, under a head of about 500 feet, making 235 revolutions and using 630 cubic feet of water per minute through a nozzle 3.31 inches in diameter; with a 4-inch nozzle this wheel will work up to 735 horse power. Perfect regulation is afforded by the use of a deflecting nozzle operated by a hydraulic governor. The nozzle is about 4 feet long with a ball joint at the butt end, and to the discharge end is attached, by lever connections, an automatic hydraulic regulator, which varies the amount of water applied to the wheel as may be needed to adapt it to varying loads—a device which affords a peculiarly simple, sensitive and satisfactory regulation. With such an arrangement, and in such a location, the advantage of water power is conspicuous. Thus the wheel above mentioned weighs but 800 lbs., and the entire equipment, embracing shaft, boxes, driving pulley, &c., only about 4,000 pounds. On the other hand, a steam machinery plant, to give the maximum capacity of such a wheel, would not weigh less than 200 tons, and the expense of running such a plant would be almost immeasurably greater

LOW GRADE ORES AND WATER POWER.

The Star Mining and Reduction Co., of Fresno County, California, furnishes a good example of low grade concentrating ores worked by water power. This company has a lode 150 feet wide, with thousands of tons of quartz on the surface, carrying galena in bunches, stringers, &c., and worth from $10.00 to $20.00 per ton in lead and silver. This ore is concentrated to about 60% lead, 60 oz. in silver, and $3 to $4 in gold, at a cost of $1.25 per ton for mining and transport, and 50 cents per ton for concentration.

The plant consists of one mammoth Blake Crusher, Cornish Rolls, screens of different fineness, German jigs, &c., in a building 136 by 60 feet, 68 and 45 feet high, stone foundation. The ore is conveyed from the mine to the concentrating mill by means of a Halliday Wire Tramway 7,000 feet long.

The capacity of the concentrating works is 125 tons in 24 hours; and the building and machinery are so arranged as to permit of this being doubled. The total cost of the plant was $40,000.

ELECTRIC TRANSMISSION OF POWER.

It has been only about two and a half years since the attention of mine operators was first called to the practicability of electric transmission of power, and the advantages of substituting, by this means, water power for steam, where water power can be had within any reasonable distance; and where the conditions were such as not to admit of a direct application. Great interest has been awakened in this subject, and rapid progress made in its development, as the following examples will show.

The Roaring Forks Electric Light and Power Co., of Aspen, Colorado, affords a very interesting application of water power to the production of electric energy, and the convenient and profitable use made of it in mining operations. This was one of the first attempts, on a scale of any magnitude, to operate the various machinery required in mills and mines by electric transmission, and the success that has attended the venture has attracted wide attention.

The power plant consists of eight 24 inch Pelton wheels, 1,000 revolutions, 820 feet head. Capacity 175 horse power each wheel. Total horse power 1,400. Single line of pipe 500 feet of 16 inch and 3,500 feet of 14 inch diameter pipe.

The power is made to conform to the requirements of the machinery run, by the use of reducing tips, so that only as much water is applied to the wheels as is necessary to run the machinery to which they are attached. Each wheel runs a separate dynamo, the connection being made by belt direct.

Close regulation is afforded by means of deflecting nozzle and hydraulic governor attached to each wheel. The station is running 120 arc lights of 2,000 candle power each; also 2,000 incandescent lights 16 candle power each, distributed over an area of some 4 miles square, and used for lighting streets, hotels, stores, private residences, &c., and in the mines, mills, and sampling works in the vicinity.

The electric power plant consists at present of one 60 horse power Sprague Motor, and six 20 horse power Sprague Motors, which furnish power to underground pump, hoists, tramways, sampling works, &c., at distances varying from one to two miles from the station.

The wheels weigh about 90 lbs. each, and (including shafting, pulleys, boxes, gates, nozzles, &c.) the proportions would be four and a half pounds of material to every horse power developed.

The relative proportion in the best type of steam plant would be from 400 to 500 pounds of material to every horse power. This plant has been in operation for more than a year and works in every way satisfactorily.

THE ASPEN MINING CO., COLORADO.

Capacity 200 horse power, transmitted three miles; running pump, hoist, tramway, &c. Started up about June 1st, 1890. Reports entirely satisfactory.

CAROLINE MINING CO., OURAY, COLORADO.

Two Pelton wheels; capacity 400 horse power; head 525 feet. Power transmitted three and a half miles through two strands of 00 wire, ground return. Machinery to be operated, 1 Knowles pump, 750 feet lift, 30 horse power hoist, 100 ton concentrating mill, 1 sawmill.

ECONOMY OF WATER POWER AND ELECTRIC TRANSMISSION.

The Dalmatia Mine, El-Dorado Co., Cal., owned by a London sydicate. The vein is a huge mineralized dyke of porphyry with quartz seams: and is opened by tunnel and shafts which cut the ore body 200 feet deep. A cross-cut 190 feet long has not reached the wall. The ores are mined by contract and delivered at the mill for 7½ cents a ton. This is made possible by reason of the large body of ore and its loose character.

The mill is equipped with three Huntington mills, crushing 25 tons a day each, and 10 stamps, crushing 25 tons a day, making the capacity 100 tons in every 24 hours. The ore is mined and milled for 50 cents a ton. This economy in the working of the Dalmatia Mine ores is due to the fact that this property enjoys the distinction of being the first quartz mine in the state run by electricity.

The plant consists of 1 Pelton wheel, 7 foot, using 400 miners' inches of water under 112½ feet head. One electric generator of 126 horse power connected with Pelton wheel two small wires to mill, one mile away, connect with electric motor or dynamo in the mill. From pulley or dynamo a belt carries the power direct to main shaft. The company are going to connect another 20 stamp with the same wires, and run it with the surplus power, making their capacity 150 tons a day.

The mill has a complete electric light plant, with turbine wheels, etc.

A 30 foot fall will drive a dynamo, and the same water can be used continually as it flows down the river. In this way power can be made on any stream to drive all the mills within miles.

The electric transmission of power reduces the cost in every instance. It allows the placing of the mill in any locality. It overcomes the difficulties attending the operating of a mine where wood and water are scarce. It saves all the expense of water for boiler, and fuel for heat, etc. There is scarcely any limit to the possibilities attending the use of electric power in mining.

Mine Discipline.*

By Peter Hormel, Essen, Pa.

In reading the accident reports of the Mine Inspector, from year to year, you will see that they treat principally of carelessness. You will see, almost from the beginning to the end, that the accidents are caused by lack of discipline and the carelessness of either the miner, the driver, the trapper, the fire boss, the superintendent, or the operator.

In most of our mines there is little or no system of discipline, and I consider it a reproach to the mining industry that so little is done to strictly enforce the rules and regulations and thereby to better the condition of the mines.

Some of you, no doubt many, will say, "that is not the case at our mine. We have a set of rules printed and framed and hung in the office or at the pit mouth, and every man receiving employment is requested to read them. We have plenty of supplies on hand at all times, and our mines, in regard to roads and ventilation, are in good condition. What lack we yet?"

Let me ask you, friend, would not the general condition of your mine and its discipline make a very poor picture in the eyes of a shrewd observer? Are you not deceiving yourself into a false sense of security?

The word discipline, in a general way of speaking, covers education, training, and government, and its enforcement by correction or punishment.

*Transactions of the Western Pennsylvania Mining Institute.

Let us consider these points briefly. Education is one of the principal means of discipline. As mining is a science, it should be learned in its different branches by all, from the boy at the door to the engineer draughting the plan of the mine, and the more educated, practical men you have the better results you will obtain in operating. When you show men how they may obtain the best results with the least labor, and insist that they do so, you have made a long step toward good discipline.

Again, training is very important. A mule may be ever so well broken to outside work, but when he is taken into the mine, you will have to train him over again before you can haul coal with him. It is just so with a man. Let him be ever so good a worker, yet he will have to be trained to mine coal, to set posts, to lay road, to watch his slate, and handle his lamp carefully in gaseous mines. Upon the last much depends, and good discipline is required to accomplish it.

One of the most difficult duties which a mine boss has is the governing of the mine, and it is often the case that a man who holds a first-class certificate cannot govern men at all.

We often see in families around us that a man who cannot govern himself seldom has obedient and well-behaved children, and things about his house generally show the lack of firm management.

It is just so with a mine. If the government is good the mine boss and the other officials will be respected and their orders obeyed and the mine will be in good condition because the men will have an interest in its success.

History tells us that a well-disciplined army will put to rout and overcome double its number of undisciplined soldiers. So in a mine under good discipline much more work will be accomplished than in one that is not well governed.

Even under the best discipline rules will sometimes be disobeyed, but generally kind words and a request not to do it again, or at most, a good firm lecture will be sufficient to keep things in order. On the contrary, under poor discipline, cursing and swearing and discharging the offender will often only aggravate the tendency to disobedience.

I do not mean to say that kind words and requests will always result in good discipline. Sometimes it becomes necessary to inflict punishment, but in such a case it should be well thought over and never be done hastily, and only when it is necessary to show that you mean what you say. A boss should be careful to say just what he means, and not, as is often the case, say one thing to-day and another to-morrow, showing that he is as changeable as the wind and hardly has any will of his own.

I have thus far given a brief definition of mine discipline and I hope suggested some thoughts, on which some of the abler members of the Institute may write more fully. I will now compare two mines, one having good discipline, and the other poor, or none at all.

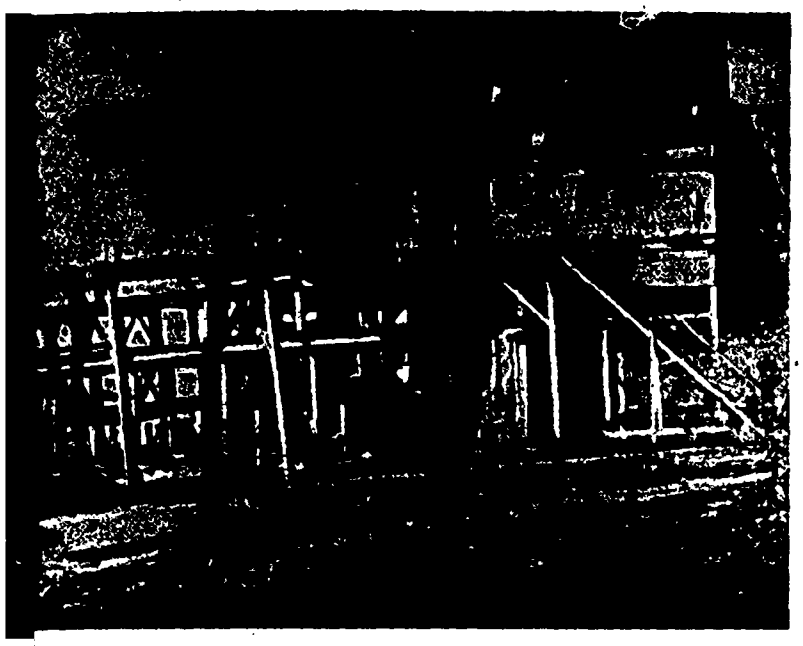
When you visit the first mentioned mine, as soon as you come as far as the tipple you will see that everything is kept in good order. You will see no rubbish lying about the place. The supplies on hand will be all sorted and kept in order and the tools in the proper place, and you can see right away that matters are well regulated as far as the outside is concerned. When you enter the mine you will find everything, including the roads, drains, and rooms, in good order, every one busy and the miner careful and obedient to all the orders of the mining boss. If you ask the mine boss a question he will answer you promptly and correctly, for he knows all about his mine and the working places of his men.

On the other hand where there is poor discipline you will see at once by the way things are lying about that there is no good housekeeper there, and if something should go wrong, you will see the men hunting around for their tools, and one will say to another, "Where did we use them last?" and if any one knows, they will find them in that place if they have not been stolen in the meantime. This is a very costly way to keep things, as the time keeps going on.

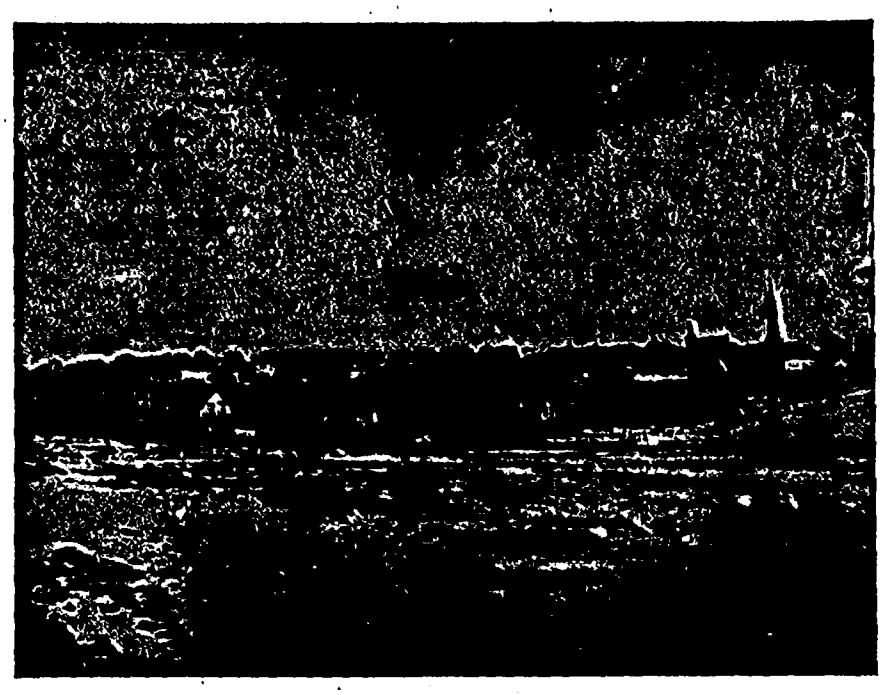
You will usually find the mine boss outside and when he sees you coming he will make a show of his authority by bossing his men about needlessly, but the men know him and do not mind him. He will have a great deal to tell you of what a good man he is, but as you go into the mine your eyes will tell you much more.

Perhaps you will meet a man, we will say the road-man, he will ask the boss, "Did you see anything of John?" The boss will say, "No, I did not." After a little you will meet John, the helper, and he will say, "Did you see anything of Mike?" The boss will say, "I saw him a little while ago." John will say, "I have been hunting for him most of the day." I might say much more in this line, but the most of you have seen the picture before as there are many such mines in Western Pennsylvania.

Now some one may say, I have tried hard to have good discipline at my mine, but failed. My friend, let me whisper one thing in your ear. Start with yourself, control yourself, govern your temper and set a good example, and I am sure you will succeed. A good motto comes to my mind, and that is: "Be sure you are right and then go ahead." Davy Crockett, the author of these words, was a poor hunter and trapper, but by energy and the practice of this motto became a member of Congress. Fellow hearers, if we only had plenty of Davy Crocketts as mining bosses, with his motto of being sure they were right before they began anything, and with energy to push it ahead when they did begin, the science of mining would be far ahead of what it now is, and the poorly disciplined mines and mine bosses would be few and far between.



THE EAST SLOPE, SPRINGHILL COLLIERY—THE SCENE OF THE EXPLOSION.



THE TOWN OF SPRINGHILL FROM THE COLLIERY.

Our Portrait Gallery.

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

No. 10.

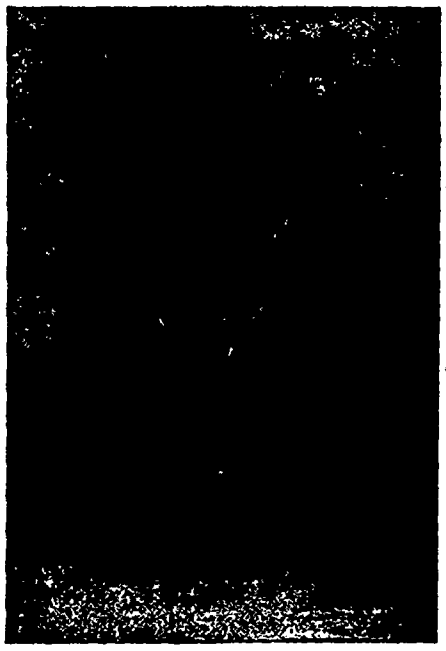
The Late Henry Swift, Underground Manager at Springhill Colliery—Killed February 21.

The late Henry Swift, Underground Manager of the Springhill Collieries, was born at Bickerstaffe, Lancashire, England, in 1850. He met his untimely death in the faithful discharge of his official duties by the colliery explosion on February 21st. By this terrible mining disaster, 124 of the men and boys employed in the pit at the time under Mr. Swift, were either killed by the explosion or suffocated by afterdamp.

Mr. Swift was a self made colliery manager. The chief industry of his birthplace was coal mining; his father was engaged in mining, and his death, when Henry was about eight years old, made it necessary that his sons should support their widowed mother. The opportunities of young Swift were limited. He attended, for a brief period, the National School at Bickerstaffe, where he obtained an elementary training, which developed within him a taste for knowledge that, in after years, he lost no opportunity of improving. At twelve years of age, he entered the employ of the Ramford Coal Company. This Company operated several collieries in Lancashire, leased from Lord Derby, father of Lord Stanley of Preston, Governor-General of Canada.

When about eighteen years old, Mr. Swift was employed as chain-runner in No. 10 shaft, which took fire. In this emergency he distinguished himself by his coolness and courage, in vain attempts to extinguish the fire. He stood at his post, up to his knees in water, till called out by the Inspector of Mines. One of the companions of his youth, Christopher Hargreaves, who was with him at the fire in No. 10 shaft, was also employed under Mr. Swift as underground manager in No. 2 slope at Springhill. They were firm friends, and to Mr. Hargreaves the REVIEW is indebted for these reminiscences of Mr. Swift's boyhood. For some time after this event, Mr. Swift was engaged in the sinking of shafts at various places, until, at the age of nineteen, he crossed the broad Atlantic to engage in mining on this continent. With several young companions he took passage on the steamship *City of Brooklyn* to New York. After their arrival they proceeded to Pennsylvania, where Mr Swift worked as a miner in the anthracite mines. He soon tired of this, and removed to Maryland, and shortly afterwards to Pictou County, Nova Scotia. There he also worked as a miner for several years

About 1874, Mr. Swift came to Springhill. He first worked as a miner, and then as a shiftman. He worked hard, and by dint of close application to details, mastered his business, and won the good opinion of his superiors. He was promoted to the position of overman, and had charge of No. 3 Slope. Next he was elevated to the position of underground manager under Mr. Hill, whom he succeeded in April, 1890. Mr. Swift was a plodding student, and was well read in mining subjects. His mining journals were preserved and substantially bound. He was eminently methodical and practical, and frequently contributed to the columns of mining journals. A posthumous letter from him signed "H. S." appeared in the March number of the *Colliery Engineer* relating the experience of a sulphur man with gas and damp. Mr. Swift was most active, and up to the time of his death spent the greater portion of his time underground every day.



THE LATE HENRY SWIFT, UNDERGROUND MANAGER AT SPRINGHILL.

Some idea of the responsibility devolving upon the manager of the Springhill Collieries—the largest in Canada—may be conveyed, when it is remembered that the daily output averaged 2,000 tons, and frequently exceeded that quantity. From 1,300 to 1,400 men and boys are employed. To superintend such extensive operations and control successfully such a small army of workmen, requires more than ordinary administrative ability.

Mr. Swift manifested a deep interest in the welfare of his workmen, and was ever ready to lend a helping hand to an ambitious young man. A few days before his death, he presented to the library of the Miners' Lodge a number of books on ventilation, the nature of gases, and other subjects of interest to the men. When the Board of Examiners for Colliery Officials was established, Mr. Swift was one of the first to apply for a certificate of competency as underground manager, which he obtained after a most satisfactory examination. He was recently elected Vice-President of the Nova Scotia Institute of Mine Officials.

Mr. Swift was married at the Albion Mines, N.S., in 1871, to Miss McLeod His wife and five children survive him. He was a member of the Masonic order, by whom he was buried with impressive rites. Mr. Swift was a member of the Presbyterian church, and for many years was secretary of the congregation. He was appointed a Justice of the Peace by the Provincial Government about ten years ago. He took an active part in the formation of a Relief Fund for the benefit of sick and injured workmen, of which society he was president. He was a man of broad sympathies, and though he led a busy life, did what he could for those who were unfortunate. His untimely death is deeply mourned by his employers, whom he faithfully served, and by many who esteemed him highly as a warm hearted friend.

The Prussian Fire-damp Commission.

Following is a summary of the report of this Commission, which was appointed to enquire into the causes of mine explosions, more particularly in regard to the explosiveness of coal dust:—

Results of the Neunkirchen Experiments.—Contrary to the English and French experiments, which had only been carried out in narrow tubes or pipes, the German Commission made an endeavor to effect its experiments under circumstances analogous to the practical working of the mine. The seat of the experiments was a horizontal gallery, 51m. in length, 1·72m. in height and 1·20m. in breadth. The middle of the gallery was improved by elliptical iron bands and and lined inside with wood; one end of it terminated in a solid mass of masonry, and the other extremity remained open. A small perpendicular gallery of the same transverse dimensions was afterwards added, for the carrying out of a few isolated experiments. Inside the masonry were carefully laid in different directions seven cast iron pipes, and a captive blower in the Kœnig mine furnished the natural gas which was required either in a pure or in a mixed state. In proportion as the experiments advanced fresh questions presented themselves, so that at the conclusion of its labours the Commission was still unable to pronounce definitely on all points; nevertheless, certain essential conclusions were established with sufficient clearness to allow of a solution of the principal question, and the way pointed out which must be followed in subsequent experiments that may be undertaken to set at rest still remaining difficulties. The principal results of the Neunkirchen experiments have been summarised in the following manner:—

1. With ordinary air all coal dusts are absolutely without danger in presence of a naked light. This harmlessness still remains, even with 4 per cent. of CH_4 in the atmosphere, although if the coal dust be raised in clouds a considerable elongation of the flame is perceptible. With more than 4·5 per cent. of CH_4, and with certain sorts of dust, the presence of a naked light causes an explosion; and with 5 per cent. of CH_4 the explosions are incomparably more violent than with 6 per cent. of CH_4 without dust.

2. In an atmosphere free from gas, the firing of a gun, charged with ordinary gunpowder (230 grammes) and with a tamping of clay, produced a length of flame from 3 to 4 m.; with a tamping of a mixture of rock and coal dust the flame increased to 5 m. in length, and with a tamping exclusively of coal dust from 9·50 m. to 16 m., according to the quantity of coal used. The nature of the coal dust appeared to have but little influence on the length of the flame.

3. The presence of coal dust within the radius of an explosion greatly increases the force of it, and with certain sorts of dust an explosion may result even in the absence of firedamp. The coal dust found in closest proximity to the flame showed particles of coke on its surface, and sometimes cakes of coke, whilst the amount of volatile gases in the coal dust was greatly diminished. The degrees of fineness of the chemical composition of the coal make themselves felt in a remarkable manner, and during the experiments it was found that (*a*) coals containing less than 10 per cent. of volatile matter are almost entirely free from danger, and elongate the flame but a very few metres; (*b*) coals consuming from 10 to 16 per cent. of volatile matter elongate the flame to 25 metres and perhaps further; (*c*) smith coal, containing from 16 to 24 per cent. of volatile matter, resulted in a flame, which in the gallery, extended as far as the coal dust had been scattered, and caused an explosion, provided the dust contained a sufficient amount of gas; (*d*) gas coal, containing from 24 to 32 per cent. of

volatile matter, yielded a less length of flame; but, which, however, extended as far as the dust, if the dust was sufficiently fine; (e) gas coal, with more than 32 per cent. of volatile matter, causes elongations of the flame only 20 metres in length, except in the use of artificially fine dust, when the flame then extended as far as the dust.

These results consequently refute the opinion that has hitherto been generally held—that only coals containing at least 30 per cent. of volatile matter could furnish inflammable dusts, and that the inflammability was in proportion to the amount of volatile matter. These experiments also prove that a much smaller quantity of dust than Messrs. Galloway, Mallard and Le Châtelier supposed necessary, will cause serious danger. Prior to these experiments being undertaken, it was thought that in order to cause an explosion there must be 1 kilo. of coal dust to a cubic metre of air.

4. In reality, there are but very few coal dusts (those of the Pluto and New Iserlohn mines excepted) which are dangerous of themselves; it is when there is a certain proportion of firedamp present, even 2 to 3 per cent., that the great majority of coaldust become imminently dangerous.

5. Coal dust is not inflamed in an atmosphere free from gas, but if the atmosphere contain from 5 to 6 per cent. of firedamp, combustion takes place.

6. The action of violent explosives on coal dusts and firedamp is much less than that of ordinary gunpowder.

7. Coal dust may be fired when blasting the mine, as well as by an explosion of firedamp.

8. In damping coal dust, the danger of inflammation is not entirely removed unless the latter is damped by a weight of water equal to about half its own weight. These results have been confirmed most evidently by the experiments made at Chatham in 1882 and 1883 by the English Commission on Accidents in Mines, also by the results obtained quite recently (1885) by the Mines Department of Saxony in the experiments made at the Brückenberg shaft, No. 1 (Zwickau), where about 100 sorts of coal dust were experimented upon.

Annual General Meeting of Bell's Asbestos Company, (Ltd).

The third ordinary general meeting of Bell's Asbestos Company, Limited, was held on February 24, at the Cannon Street Hotel, London, E.C., Mr. John Bell (the chairman of the company) presiding.

The SECRETARY (Mr. R. Lauder McLaren), read the notice convening the meeting; the report and accounts were taken as read.

The CHAIRMAN said: Gentlemen, I will just make a few observations upon the leading items in the accounts. The bills receivable are stated at £10,273 as on December 31, since which about three-fourths of them have fallen due, and, as a matter of course, have been paid. I say as a matter of course, because they would not be kept in their position in the accounts next to the cash—they would not be allowed by the auditors to be so kept—if there had been any doubt with regard to them. All of you who have any experience of the auditing of Messrs. Cooper Brothers & Co. know perfectly well that all such things as allowance for bad and doubtful debts, writing off for plant or stock, and so forth, are always strictly and severely attended to. A very full allowance has been made for bad and doubtful debts, and, therefore, the £31,723 that you see there is as good as the bills to which I have just referred. The stock has grown during the last year, from two causes: We made some purchases in advance of our requirements, which we considered of a very advantageous nature for the company, and the decline in the trade mentioned in the report has caused an accumulation of stock; but everything that may be called old and obsolete—and we have very little—has been put down at nil. You may take it that the general principle is that the stock is valued simply at cost price. I never saw a safer figure in the assets of any company than this £51,599 in the balance-sheet placed before you to-day. With reference to buildings, plant and machinery, fixtures, and so forth, you will recollect that when this business was taken over by the company it was stipulated that the plant and machinery were purchased at the price at which they stood in the books of John Bell & Son, subject to an independent valuation, and an independent valuer estimated them at double the amount, or thereabouts, at which they were taken over by the company. (Hear, hear.) That was due to the severe writing down which had taken place for several years previously, and that same severity in writing down has been continued since the formation of the company, and, therefore, that item of £6,837 may be taken as a very good asset. (Hear, hear.) The asbestos estates in Canada were purchased by the company from John Bell & Son at the exact price at which the firm had acquired them, and that fact, as it was a magnificent purchase by the company, was part of the consideration for the good-will paid for that firm. The mines at the present day are worth vastly more than the sum paid for them and the total goodwill put together. (Hear, hear.)

I have never considered it my duty to enter into newspaper discussions about the affairs of this company; I have always considered it to be the reverse of my duty. Therefore, I have not replied to various criticisms made at different times, but have been rather inclined to let calumny die out. But in deference to the wishes of many of our best friends, and especially of many of our best customers, I have something to say to-day, and some very plain things in the way of pointing to what lies at the bottom of the decline in our trade during last year. (Hear, hear.) A year ago it was my duty to lay before you the system on which we follow the very common practice of giving gratuities to those who have the practical handling of the goods we sell. I told you, in words which could not be honestly misunderstood, that we had never given a penny to any man to cover inferior quality or shortness of weight or measurement; that in no sense or degree had we ever corrupted any man by a bribe or inducement to do wrong. (Hear, hear.) You gave your sanction to our action in this matter, and very soon after the First Lord of the Admiralty stated in the House of Commons, in reply to a question, that the name of our company had, on this account, been removed from the list of contractors to the Admiralty. If we had been asked whether we had anything to say for ourselves, we should have been able to reply that during our ten years' dealing with the Admiralty we had never given a penny to any servant of the department, that no mark stood against us for failure of our material under any circumstances, and that we had never been wanting as to weight or measurement to the extent of a single gramme or millimètre. (Hear, hear.) We could have added that the most important forms in which asbestos is used in the navy had been first designed and worked out to practical use by us, at great cost of time, labour, and money. No such question, however, was put to us, and, as was not unnatural, the belief became general in the public mind that such a denunciation in the most public place in the world, in language of marked severity, by a person of high position and responsibility, was the result of an official investigation by means of which we had been convicted of corrupting public servants. It suited and still suits the purpose of previously very unsuccessful trade rivals to propagate and foment, by many devices, the impression that we are not as honourable traders as they. A certain section of the so-called financial press had been useful allies of our trade rivals in furnishing specially dished-up articles and paragraphs which zealous commercial travellers have brought under notice in thousands of places where, but for their efforts, such papers would never have been heard of. Set going by so powerful an authority as the First Lord of the Admiralty, the campaign against us became fashionable, and gained strength as it proceeded. The sowing of wicked calumny broadcast became easy of accomplishment, and has been fortunate in achieving such success as all efforts on the part of its chief promoters to rival us in the excellence of our manufactures and in the success of our trade had utterly failed to attain. We have to own that what fair competition could not do, persistent detraction in private and in public has accomplished, the result being that during the past year we have lost a large amount of trade. I shall endeavour to show you, not by dry reasoning on abstract principles, but by an appeal to your own every day experience, that to point to this company as something out of the common, and to make up against it a charge of bribery and corruption, is outrageously unjust, and I hope to leave on your minds a conviction that having stood so well as we have stood, the heat of the first onslaught, we shall eventually come out of this contest chastened, but not vanquished, and that we shall regain our former hold of the first position in our trade, which, though it has been shaken by the events of the past year, no one has yet been able to wrest from us. (Cheers.) Thus, I shall hope to justify the belief expressed in the report, that the decline in our trade will not be permanent. (Cheers.)

I have declared to you, but let me, by repetition, emphasise the declaration, that we have never given a penny to any man to cover defect of quality, or short weight or measurement. No man has ever ventured to say that we have, though there are those who would give much to be able to say so. True, we bow to the rule of "backsheesh," as it is allowed to prevail in all countries, and among all sorts and conditions of men. It is not enough to say none are too low for it; we must also say none are raised above it. Bribery and corruption are not so allowed to prevail; the humblest despise them as sincerely as the highest. But gratuity giving in an infinite variety of forms, though nowhere commended, is everywhere practised without reproach to him who gives or to him who receives. (Cheers.) Take an instance or two. A railway porter secures for you, to the exclusion of someone else, a comfortable corner seat and gets sixpence; but the man opposite to you has given somebody half-a-crown so that he may travel first-class at third-class fare. You have given an unlawful gratuity, which cannot be defended on abstract principle; but nobody accuses you of bribery and corruption, as they rightly do the fellow opposite you. The good sportsman, respected merchant, esteemed director of the great railway and steamship companies—even a noble lord (if he be not one of the Admiralty)—when he sells a horse gives a sovereign—sometimes more—to the groom of the buyer. Why does he give this unlawful gratuity if he honestly believes the animal to be all that he has described him to be? Why, he follows a custom, and he feels himself safer in doing so than he would if he kept the money in his own pocket. Who dreams of accusing him of bribery and corruption? In the shooting season the moors of Scotland are crowded with directors, managers, superintendents, and all sorts of people who can influence or give out orders. They are not on the moors at their own expense. Luxurious yachts career over the seas filled with such men, also not at their own expense. Here is a vast use of what, strictly speaking, is undue influence to gain a trade object. But who calls it bribery and corruption? Who ever proposes to strike his host's name from a list of contractors because of it? Yet, if I give a weekly-wage earning mechanic a couple of sovereigns to help him to afford his family a summer holiday at Blackpool or Margate, up go your eyes and out comes the Pecksniffian howl—(laughter)—against bribery and corruption. Your solicitor—I know my friend Mr. Stibbard has always been one of the exceptions which prove the rule—gets a commission when he influences you to insure your life or property in a particular office. Some bankers get a return of brokerage when they employ a stockbroker to invest your funds. Some great railway companies tip forwarding clerks to secure a preference of goods traffic for their lines. Makers of steam engines propitiate the man who is to drive a new engine just laid down. Even these remarks of mine will, in certain places, be favorably commented on, or the reverse, according as we are liberal or otherwise in purchasing copies of certain journals for distribution. (Laughter.) One more example in a region where one treads with reverential care—the region of high justice. When commercial companies go into liquidation, it often happens that an eminent public accountant is appointed by the court to carry on the business, and such official manager finds that he has to fall in with this practice of gratuity-giving, or the business would come to a deadlock. He applies for and obtains the sanction of a judge. This, of course, could not be if all gratuity-giving for the furtherance of business was bribery and corruption. (Hear, hear.)

I might occupy much more of your time in pointing out scores of facts in your own everyday experience, showing "backsheesh," which is universally admitted to differ from bribery and corruption, is used throughout all grades of society to further the ends men have in view. But why dwell on what is in every man's conscience? My point is not that gratuity-giving is right, but that Bell's Asbestos Company is not different to other men, that we are in the common swim, and that this fact must come to be acknowledged as a fact; and thus men will see that we are more sinned against than sinning, and that as the public judgment in regard to us regains it balance we shall recover the trade which has been, without due cause, withdrawn from us. Some of you shareholders in this company are employers of labor, and are users of steam power. If you wish to do away with this system of gratuity-giving, you must do something more effectual to the purpose than transferring your account from us to one of the opposition concerns. You must go below the surface, and recognise that this matter has its root in the never-ending struggle between capital and labour; that it is an outcome of the determination of every man to use any power he possesses to get something beyond the bare necessaries of life; and if you don't like the form of it, set yourselves to provide a substitute for it. It is that substitute which the directors of this company are anxious to find, and we are ready to co-operate with any set of employers who will honestly deal with this question on the human, not the Pharisaic principle. Now, gentlemen, shareholders in this company, do your part. Let no man in your presence venture to accuse this company of bribery and corruption; tear the mask away wherever you meet it, and assert your company as better able to look the world in the face than any of its traducers. (Applause.) Do this boldly and constantly, and you will soon have your dividends over 20 per cent. again. Let us now pass on to the Canadian properties of the company. The use of asbestos in the manufacture of steam packing and as a non-conductor in various forms has greatly grown, and the consumption has completely caught up the supply obtainable from such mines as are in efficient working at Thetford and some less important outside places, but no new application of the material calling for large quantities of it has come to light. For the present trade the mines now in work can furnish what is required, and the remunerative prices which have now become established will sufficiently stimulate production at these mines to meet the growing demand until some new use of asbestos calls for larger quantities than can be supplied from the present sources. We have not abandoned, as certain busybodies have alleged, our Bellmina and Hayden estates. We have them in reserve, and when the growth of our trade requires us to break into new ground, your directors will not hesitate to do the work. Meanwhile we shall be content to make money quietly and safely at Thetford. We have made very important forward sales of the estimated surplus of crude asbestos over our own manufacturing requirements during the present year. I am under engagement to the buyers not to mention quantities or prices, but I may venture so far as to state that these sales will, with ordinary good fortune in the working, give us a very much larger profit than has ever previously been obtained from ours or any asbestos mines. It is true the effect of these sales will be somewhat watered by previous contracts at much lower prices, the fulfilment of which to some extent runs into the present year. It is also probable that the fact of there being a quantity deliverable by us at comparatively low prices has militated against our obtaining so high a value as we should otherwise have secured. I am, however, very sure that our policy of dealing freely at the prices obtainable in the natural course of our trade is the right policy, and we have done so well in these present contracts that regret is out of place. The income now being derived from the Thetford Mine places the value of that estate at a higher sum than was paid by the company for all the properties and goodwill of the business taken over. We are very desirous of strengthening the board by the addition of a member possessing the necessary experience and influence to make him a real acquisition to the company. We want

a man whose knowledge, experience, and influence count for something among steam users, and a man who will be satisfactory to our altered list of shareholders. We are in very full communication with a gentleman of first-rate commercial standing, and of the sort I have just described, and I hope that we shall soon be able to make an announcement on this subject which cannot fail to be satisfactory to the shareholders. In this matter the directors have given special attention to the change which has taken place in our list of shareholders. Our shares have now passed out of the few hands in which they were held in large blocks, and, instead of a trifle over 300 shareholders to whom we allotted, we have now about 900 members. This altered condition of our share list may, and probably will, bring about important changes. One beneficial change that we look for is that, as small shareholders take more direct interest in their investments than great ones, therefore, the spread of your stock into many hands will strengthen the company in many ways and advance its trade. I now move: "That the report of the board of directors and the auditors, and the financial statement, submitted to the meeting, be, and the same are hereby, approved, adopted and confirmed. (Cheers).

MR. T. B. LIGHTFOOT seconded the resolution.

MR. ATKINSON asked a series of questions, which he had had printed and circulated amongst shareholders at the meeting.

MR. LOUIS HIRSCH asked if Mr. Atkinson was a shareholder in the company.

MR. ATKINSON.—I have a receipt for my transfer in my hand.

MR. HIRSCH.—How many shares?

MR. ATKINSON.—I have been sent by gentlemen who have lost a lot of money over this company. (Cries of "How many shares?") I hold one share. (Laughter, and cries of "Sit down!") That was presented to me --(laughter)—by gentlemen who have lost hundreds of pounds by the shameful rigging of asbestos.

MR. HIRSCH.—I have just been informed that Mr. Atkinson is not a registered shareholder, therefore he has no right at this meeting at all; certainly no right to speak. (Hear, hear.) I think it is a presumption.

MR. ATKINSON.—I do not want to say any more.

MR. HIRSCH.—You have said quite enough. I should propose, Mr. Chairman, that you do not answer those impertinent questions. No registered shareholder desires them to be answered.

The CHAIRMAN.—I could not possibly answer a person who is not a shareholder.

MR. HIRSCH.—I should propose that the person be requested to remove himself, or else we shall have the unpleasant duty of removing him. ("Hear, hear," and laughter.) It must be patent to every shareholder that persons who ask questions like this have not the interest of the company at heart. (Hear, hear.)

MR. RIDLEY here rose and said he would put the same questions to the chairman.

MR. HIRSCH hoped the chairman would take the sense of the meeting before he answered them.

The CHAIRMAN.—There is no difficulty in answering them, as a shareholder has put them. The Chairman then dealt with the questions seriatim, as follows:—"Is it true that there is an action pending against Bell's Asbestos Company, instituted by Messrs. Ward and King, either jointly or severally, or any other Canadian mine owner, for damages for encroachments upon asbestos property?" There is no action whatever against the company by any firm of persons named Ward and King. We have had to enter an action against Mr. Ward to remove him from a portion of our property. It is a boundary dispute. Some people named Johnson, who think we are trespassing on their property, commenced an action against us. These are very minor matters—the claim against us is in respect of 9 ft. of land. (Laughter.) We claim from Mr. Ward 22 ft. of land. We are advised that we are sure to win. "Is it true that there is an action pending against Bell's Asbestos Company brought by a firm in Aberdeen for damages for alleged defective machinery or plant supplied or fitted or other causes?" It is not true; nor has anyone else in Scotland commenced an action against us. "Is it true that about 150 tons of crude asbestos, which has been valued at about £40 a ton, has to be delivered at about £20 a ton?" No; not a word of truth in it. "Is it true that about 350 tons of crude asbestos has to be mined and delivered at about £20 a ton this year?" Yes: we have more than 350 tons to deliver at £20, and a very profitable price it is, too. (Hear, hear.) "Has there been any loss during the year ending December 31, 1890, on businesses at London and branches? and, if so, how much?" No; there has been a profit. "Will it be necessary to spend any money on the Canadian mines this year? and, if so, how m[illegible]?" Of course it will; we spend money every year upon them, and cannot get the stuff out without. (Laughter.) "How much is expected to be spent on new buildings in London or elsewhere this year?" About £15,000. "Is there any special reason why the goodwill, patents, etc., should be valued at £69,101 18s. 8d., the same amount as inserted in the first year's balance-sheet, when it is stated by the board that the home business is declining?" The reason is simply this, not to go into any question of goodwill on the general business, which, everybody must admit, is worth something: the position we occupy is that we have estates in Canada worth more than was paid for all the estates and properties and goodwill put together. (Applause.) "Is the system of 'tipping' still continued by the consent of the board?" I decline to go into any question of the internal management of the company with anybody. (Hear, hear.) "Is the Mr. Sheredan who sent such glowing reports respecting the Harnhalli Gold Mine related to the Mr. Sheredan who is manager of Bell's Asbestos mines in Canada?" I do not believe there is any relationship between the two Mr. Sheredans referred to; I have never heard of it.

MR. ATKINSON was about to speak again; but

MR. HIRSCH rose to order, and told him he ought to be grateful to the meeting for allowing him to be there at all. (Laughter.)

The resolution was then put, and carried with one dissentient—Mr. Ridley.

The CHAIRMAN moved the declaration of a dividend of 5s. a share, free of income tax, making a total distribution, with the interim dividend, of 15 per cent. for the year.

CAPTAIN A. J. BURNETT seconded the motion, which was agreed to.

The retiring director, Mr. T. B. Lightfoot, was re-elected on the motion of Captain Burnett.

The auditors, Messrs. Cooper Brothers & Co., were re-appointed on the motion of Mr. Bird, seconded by Mr. Long.

The proceedings then closed with a vote of thanks to the chairman.

A New Process for Gold Extraction.

A new process for extracting gold from pyrites has been brought out in South Australia, and patented in other parts of the world. It consists in calcining the crushed pyrites in a furnace at a low degree of heat, operations being expedited by introducing a jet of gas containing an excess of oxygen, into a hollow cylinder, in which the ore is being roasted. The cylinder is made to revolve in the centre of the furnace, at a slight inclination from the horizontal, so that as it turns slowly round, the pulverised ore finds its way gradually from the upper to the lower end. Within the cylinder are a number of small flanges for the purpose of raising and carrying round the ore, which, by this means, drops clear from the top to the bottom of the cylinder, and is thus exposed to the full force of the jet of gas before mentioned. The ore is fed into the cylinder through a hopper, and the lower end is left open. On the crown of the furnace is an iron retort, which is charged with crude nitrate of soda wetted with acid. Nitrate and hydrochloric acid are obtained, and sulphuric acid from the sulphur contained in the pyrites. These products are derived from the gases which are stored in a chamber constructed for the purpose. The retort has a curved pipe descending into the open end of the cylinder, so that the jet of gas plays full into it. In the working model made by Messrs. May Brothers, engineers, of Gawler, the cylinder was 5 feet in length, and the time occupied by the ore in passing through it, under 12 minutes, by which time the calcination was complete, and the pyrites decomposed. The ore could then be at once amalgamated with mercury, but the present plan is to transfer it at once into a bath of *aqua regia* composed of the acids before mentioned. By allowing it to remain in this bath for from 15 to 30 minutes, the gold is dissolved, and the liquor is next filtered through charcoal which retains the gold, and the charcoal being placed in a furnace the metal is smelted and recovered.

It is claimed that the process will save 95 per cent. of the gold contained in the pyrites, and that the cost of the operation will not exceed 4s. per ton of pulverised ore, which cost includes interest on the plant required. The cost of a plant capable of treating 100 tons per week, is estimated roughly at between £300 and £400. Hitherto, by most of the ordinary processes, it has been difficult to save more than 50 or 60 per cent. of the gold in pyrites, so that if the patent saves even 90 per cent. it is a vast improvement upon the methods commonly in use. Not only is its advantage seen in saving 15 dwts. where only 10 was got before, but in the lower cost of the process, so that 1 dwt. of gold would about cover the cost of saving 15 dwts., whereas 2 would be required to recover the 10 dwts. The inventor claims, as part of his patent, the right to use any peroxide in treating ores, and to apply the process to other metals besides gold. He is about to experiment on the zinc ores, which abound in the silver mines at and around Broken Hill, and is sanguine of being able to separate the zinc, which, though valuable, is mostly lost at present. He considers that the same principle is applicable also to the treatment of copper pyrites.

The working model above referred to is capable of treating about 30 cwts. of ore per diem, and the experiments have been thoroughly successful. In fact, the inventor and his friends satisfied themselves by repeated experiments of the effective nature of the invention before they went to the expense of patenting it in nearly all the important gold producing countries of the world. It is intended now to erect works in Adelaide on a large scale, so that pyrites can be treated in quantity. Amongst other advantages possessed by this process are (*a*) the saving in grinding the stone, as screens of 100 holes to the square inch are quite fine enough, the desulphurising process effecting all that is required on that grade; (*b*) in treating sulphide ores an excess of liquor is produced, and is available for the treatment of other stone containing very fine or "flour" gold, which can by this means be readily saved; (*c*) the entire removal of the sulphur is not necessary so long as the pyrites is decomposed; and (*d*) it is impossible to slag the ore as it must come out perfectly oxidised.

MINING NOTES.

Quebec.

The output from the Phosphate of Lime Company's mine at High Rock during February was 580 tons. A force of 175 men was employed. Mr. Walter Pickford, the superintendent, has returned from his visit to Florida.

Mr. James Cooper, president of the Ingersoll Rock Drill Company, and Mr. George R. Smith, have returned from England, having succeeded in forming a company to operate the Pearson property in the Templeton District. Details of this company will be found in our company column.

We would also direct our readers' attention to the formation of the first English company to operate the asbestos deposits of the Ottawa Valley, under the title of the Templeton Asbestos Mining Company.

The output from the New Rockland Slate Quarry, at New Rockland, for February, was somewhat less than last year. About 150 men are now employed, but this force will be doubled in a week or two. It is understood that several important additions to the plant will also be made.

Mr. Mercier having gone to Europe without giving any attention to the request of the General Mining Association for the repeal or amendment of his obnoxious bill, a meeting of the Council of the Association has been called for the 1st prox., to consider the advisability of having the bill vetoed in the coming session of Parliament.

Ontario.

Mr. Francis L. Sperry, who has been with the Canadian Copper Company since they began operations in the Sudbury nickel field in 1886, has resigned his position of chemist, and is now located in Sudbury. He will devote himself hereafter to advancing the mineral development of the Sudbury region.

Manitoba and North-West Territories.

The Lethbridge Coal Co's pay sheets for last month for the mines include 588 names, and for the railway and workshops 398, making a total of 986 employes. The total amount paid out in wages alone was over $50,000. Several of the miners drew over $100 for the month, two going as high as $117 each. Besides the above the company's bills to the merchants of the town for supplies amount to about $15,000.

British Columbia.

Cariboo District.

The Waverley Hydraulic Company of Grouse Creek, have not as yet reached bed rock with their cut, but their wash-ups improve as they get nearer the bottom of the channel.

The Forest Rose, Taylor and Black Jack Companies, on Williams Creek, have paid fairly well last year.

In his annual report to the Minister of Mines, Mr. John Bowron, G.C., writes: "The opinion has prevailed for many years among our most experienced miners from California and Australia that, judging from the formation of the country, there existed, and ultimately would be found in this district, immense obliterated river channels traversing the country upon a higher level than the present streams, which in crossing the former, in many instances, received therefrom their chief supply of the precious metal. The first of such ancient river channels would now appear to have been discovered on the south side of the South Fork of the Quesnelle River. A Chinese company working up Dancing Bill's Creek, three miles above the Forks (*vide* Mr. Bowman's map), when about a thousand feet from the Quesnelle River, and at an altitude of one hundred and twenty-five feet above the stream, came to a pitch off in the bed rock which they were unable to follow, owing to the quantity of water encountered. They continued working ahead as near on a

level as the grade to the sluices would allow. This occurred some ten or twelve years ago, and they have continued since that time to work into the hill without finding bed rock. They use hydraulic pressure in working; but as their water supply is limited, and the face of their cut is now nearly two hundred feet in height, they make but small headway, but are known to have been taking out, with six men working, from five to eight thousand dollars annually. The operations of this company having for some years been watched with interest by the white miners in the vicinity, and the developments seeming to confirm their pre-conceived ideas of an immense 'blind' river channel in the hill, Messrs. Barker, Polley, Burrill & Co. sank two shafts half a mile above the Chinese Company, and back some fifteen hundred feet from the river, behind the rim rock which forms the river bank, and although not reaching bed rock, owing to the quantity of water encountered, they found similar prospects to those obtained in the Chinese claim. Subsequently, Mr. John Hepburn, of Victoria, located ground below the Chinese, and in running in cuts developed similar pay gravel inside the rim rock, which is regarded as settling the question of a paying channel in the hill beyond a doubt. Messrs. Whittier & Pomeroy below, and the Champion Company above, have also located ground until there are nearly six miles of the channel claimed. Some are of the opinion that the channel will ultimately be traced to the Horsefly River, some twenty miles distant. However that may be, it is generally conceded that there must be at least ten miles of the old river bed. As to the richness of the pay, and consequent importance of the discovery, I can only say it is estimated that the Chinese Company are taking out at least one thousand dollars per lineal foot of the channel so far as they have worked, and as large river channels are usually very regular in the gold deposits, further comments are unnecessary."

Mr. Bowron's estimate of the gold yield from alluvial diggings in this district, is as follows:—

Barkerville Division, to the 15th Nov..		$ 61,200
Lightning Creek Division,	" ..	38,000
Quesnellemouth,	" ..	26,250
Keithley Creek,	" .	62,000
Probable product from 15th November to 31st December, say.....		8,000
		$195,450

The destruction by fire of the Government Reduction works, last winter, had a depressing effect upon the quartz industry, but now that these have been rebuilt and in operation again, the indications point to increased energy in this promising field.

The Black Jack Quartz Mining Co. have during the season prosecuted work on their mine; their shaft being now down to a depth of something over 100 feet, and exposing a valuable body of ore. Their small prospecting mill was kept running a good part of the time until stopped by frost. This company has taken another lot of sulphurets to the test works, which is now under treatment. A most satisfactory test of the ore from this mine was made at "The Cassell Gold Extracting Co's Works," Glasgow, Scotland. From 360 pounds of ore sent a result of something over $80 per ton was obtained; the ore worked up to 90% of the assay value. The advantages of this company's method is that no roasting is required, and the company claim that in ordinary cases ore can be treated for one-fourth the cost of working by the chlorinating process, a circumstance which, if substantiated by further working tests, means wealth to this district.

The Island Mountain Co. completed their ten-stamp mill, to which are attached four concentrators and an improved rock crusher, and the machinery was put into operation about 20th August, and was found to work satisfactorily. Rock crushing commenced on 25th August, and by 25th September several hundreds of tons were put through. Some difficulty was experienced in getting the silver plates to catch the gold, owing to the presence of some foreign substance coating the plates, but after a time this was partially remedied. Some fifteen or twenty tons of sulphurets were saved and brought to the government works for treatment.

West Kootenay.

On McCulloch Creek the Last Chance Company's tunnel is in 1,150 feet, without any sight of bed rock. The supposition was entertained that the bottom of the channel would be reached in 600 feet, but this has proved a mistake.

The Ophir Bed Rock Flume Co. has put in the necessary amount of fluming to comply with the conditions of their lease. No ground has been worked in consequence of litigation between some of the shareholders.

Lund & Co., at the mouth of Smith's Creek, procured very good returns towards the latter part of the season. A new ditch will be constructed to obtain 300 feet of pressure, and iron piping and a monitor nozzle are to be forwarded by boat early in the spring. The pay has been definitely determined in the deepest portions of the channel, which is about 500 feet wide.

Gold Commissioner Tunstall, writing of the Lardeau River country, says: "On the 4th of August a party consisting of Peter Walker, Lochrie McDonald, Tom Downes and Charles Holden, purchased an outfit at Revelstoke and started in a small boat down the river. They proceeded to the head of Upper Arrow Lake and went up the East Arm, where the boat was left, and a trail cut to Trout Lake. They returned on the 20th November, and reported having prospected a creek which pursues a southerly course and flows into the lake at its head. Holes were sunk in a bench at the side of the canyon, about two miles above, and coarse gold found on the bed rock, but not in sufficient quantities to prove remunerative. Below the canyon the water prevented their attempts to bottom the channel. The prospects obtained indicated that a heavy run of gold exists somewhere in the vicinity. It is their intention to return early in the spring and resume operations.

Under the able superintendence of Mr. Jas. Brady, C.E., the tunnel in the Lanark is now over 500 feet long, 300 feet of which was completed this season. The lode in this claim is from 2½ to 5 feet wide, and of a high grade character. Sixteen car loads, shipped some three or four years ago, returned in silver alone 89 oz. to the ton. The company has expended a large amount of money in developing its property, and is deserving of the utmost success.

The Maple Leaf has two shafts sunk, one at the upper end of the claim 35 feet deep, the other at the lower extremity 45 feet. The vein is 4½ feet wide. Returns from a recent shipment gave a yield of 90 oz. in silver, 1/100 oz. gold, and 28% lead.

The Cariboo Company has, during the year, extended its tunnel 100 feet further. The vein is galena lying between walls of porphyry, and varies from 6 to 12 feet in width.

In concluding his report Mr. Tunstall observes: "It is a matter of surprise to every one that the Illecillewaet sub-division has not attracted more attention from capitalists and mining men in general. Many of the veins are rich and well defined, exhibiting large bodies of ore, and possessing the great advantage of being situated within easy reach of a railway, and, in some instances, quite close to this means of transportation. It is, therefore, not owing to the absence of any of these features that development has not been more actively prosecuted, but to the fact that here and elsewhere the majority of mine owners cannot afford the heavy expenditure required for that purpose, and they demand too high a price for their property to secure the investment of capital. Some of the richest mining sections in the adjoining States have experienced similar periods of depression, ascribed to the same cause, until the capitalist was offered sufficient inducements to come to their rescue. It is evident that a more liberal course will have to be pursued to attain the benefit of the great wealth lying dormant by this means in the principal mining districts of the Province."

The celebrated Hall Mines, comprising the Silver King, Kootenay, Bonanza, and American Flag, are situated on the summit of Toad Mountain. They would have employed a large number of men last summer had it not been for the litigation in which they were involved. The tunnel in the Silver King is 330 feet long, in which are employed fourteen men. A large amount of ore is on the dump awaiting the completion of the waggon road for shipment. One hundred and ten (110) tons of ore were forwarded last fall from this mine to Helena, Montana. It was taken from a cross-cut at the bottom of the incline, and sampled from $404 to $414 to the ton in silver and copper.

In consequence of mine owners withholding shipments for the completion of the Columbia and Kootenay Railway, but 205 tons of ore were exported for smelting purposes, of which 110 tons from the Silver King, Toad Mountain sub-division, sampled an average of $409 to the ton in silver and copper, representing a value of $44,990. The respective amounts of silver and copper were not ascertained; and ninety-five tons from the Skyline, Hot Springs sub-division, yielded 280 ounces in silver to the ton, which, at the present value of that metal in New York—$1.09 per ounce—is equivalent to $28,994, making an aggregate of $73,984. The estimated yield of gold from quartz and placer mines is $35,000, the Big Bend returning less than one half its usual output this year.

The number of records effected at the various offices is as follows: Revelstoke, 203; Nelson, 665; Ainsworth, or Hot Springs, 700; Trail Creek, 65; during a period of ten weeks.

"Everything," says Mr. Tunstall, "points to a season of unusual activity this year. The mineral areas are steadily increasing in number and extent by the new discoveries made from time to time. With the increase of ore production other industries will spring into existence, and a large and prosperous population be sustained. The completion of the Columbia and Kootenay railway will be effected in the spring; and measures are now being taken for the erection of an ore shed, and construction of a wharf 600 feet long to deep water. The Columbia and Kootenay Steam Navigation Company are building a new steamer in the vicinity of Nelson, to ply on the lake, possessing a capacity of 135 tons, which, with barges and the addition of the present fleet, will be able to accommodate the increased demand for freight. It is also stated the Hendryx Company will build and equip a steel steamer to run between Nelson and Bonner's Ferry, stopping at way ports.

East Kootenay.

The Monarch mine, situated on Mount Stephen, near the summit of the Rockies, a quarter of a mile from and at an elevation of 850 feet above the Canadian Pacific track, is at present the only fully equipped working mine in the district. The company has resumed work this fall. A force of ten miners is now at work, terms having been arranged to supply the Revelstoke Smelter Company with 200 tons of ore per month. The shipping ore averages about 60 per cent. lead with 10 of silver to the ton. The ore occurs in somewhat irregular chambers, pockets and other deposits in the limestone, with but little gangue, and seems abundant. It is expected that the mineral will lie in more regular form and even greater body when more depth into the mountain has been reached. The mine was discovered in 1884. About 1,500 tons of ore have been extracted and shipped up to the present time. The underground workings amount in the aggregate to about 450 feet of tunnelling, with larger chambers opened out in places where ore was more abundant. A considerable amount of work has also been executed on the outside, consisting of a tramway, galleried out of the face of the mountain, leading to the principal ore bins, and a gravity road from thence to the bins on the railroad, together with all the necessary plant for working the mine.

Lillooet.

The total yield from the Lillooet district for last year is reported, by Mr. Soues, at $71,455; an increase of $11,000 as compared with 1889.

The Lillooet Hydraulic Mining Company, located near the Fraser River Bridge, have been working all the season day and night, most of the time with good success. This same company have just diverted the south fork of Bridge River for over half a mile, and will commence to mine the old channel in the early spring with a strong force of men, using three parallel lines of sluices. They sank two prospect holes and found good indications; from one they took out $24.75 in coarse gold. This company is deserving of every success, as they have spent over $13,000 in opening the two claims.

The Vancouver Enterprise Company have their tunnel in 270 feet, over half-way, which will be completed in the spring, as the company propose keeping steadily at work during the winter. This tunnel will enable them to work their leased ground on Cayoosh Creek to bed rock, and as the Chinese miners, who were discoverers of the gold in this creek, took fully $160,000 from the surface workings, it is reasonable to suppose that the company will find it proportionately rich near to and on bed rock. The Deadwood mine, owned by Messrs. Whittier & Co., has been worked night and day most of the season with good profit.

Under the Mineral Amendment Act, 1890, five leases for hydraulic mining have been granted during the year. On three of these active work has been done. On the other two, which are located on the east side of Fraser River, opposite to the town of Lillooet, it is proposed to bring in water from Cayoosh Creek, which will necessitate a very large outlay of capital. On the leased ground on St. Mary's Creek, and on that of Fraser River Cable Company, there has not been any work done during the past season. Both of these claims are practically abandoned. Very little has been done in alluvial mining on Cayoosh Creek, Bridge River, and tributaries during the season.

Vancouver Island.

Mr. Archibald Dick, Chief Inspector of Mines for the province, officially reports the total coal yield for 1890 at 678,140 tons, produced as follows:—

	Tons.
Nanaimo Colliery.....	389,505
Wellington.....	174,496
East Wellington.....	44,602
Union	69,537
	678,140
Coal on hand 1st Jan., 1890	20,508
	698,648

The exports were as follows:—

	Tons.
Nanaimo.....	292,809
Wellington	106,281
East Wellington	35,132
Union	74,048
Total exports	508,270

In addition, the Canadian Anthracite and Coal Co., at Banff, sent via Vancouver, 2,300 tons.

The colliery returns show a home consumption of 177,075 as compared with 124,574 tons in 1889.

The progress of the industry may be judged from Mr. Dick's summary as follows—

	Output.	Export.
1887	413,360	334,839
1888	489,300	365,?14
1889	579,830	443,675
1890	678,141	508,270

In concluding an excellent review, Mr. Dick says: "While all the mines are being worked with vigor and

unprecedented energy, and with an immense investment of capital, for which there is the best prospect of a safe and profitable return to the lucky proprietors, I sincerely trust that the unhappy differences which have existed lately in this district will be adjusted, and harmonious relations be restored between differing employers and employed, as such a consummation would tend greatly to advance the coal industry and the prosperity of the community, as well as to place this province in a proud position as commanding the market of the Pacific slope, whether as to quality, quantity or price of the great staple article of necessary utility—coal. The outlook for the year we have now entered upon (1891), is the most promising that it has been my good fortune to experience for the coal industry; the harbors of the port of Nanaimo are replete with shipping of every possible size, from the largest ocean ships and steam vessels to the small towing craft and capacious barges, and the powers of the collieries have been strained to the utmost to fill orders to the many comers. I need hardly say that the city of Nanaimo has been a large participant in this stream of prosperity that has visited the district, and I trust that it may long continue and increase."

CANADIAN COMPANIES.

Mattawa Mining and Smelting Company.—This company has been organized with a capital of $300,000 to mine in the County of Pontiac, Que.. Head office, 102 Broadway, New York; mine address, Baie des Pères, Pontiac Co., Quebec. The officers are R. W. Chapin, president; W. L. Turner, vice-president; Edmund Coffin, jr., Secretary-Treasurer.

The Moosomin and Souris Railway and Coal Company.—Application will be made to the Dominion Parliament for the incorporation of the above company, with power to construct and operate a railway from a point on the line of the Canadian Pacific Railway Company at or near Moosomin, in the District of Assiniboia, to a point at or near the international boundary, in Township one, Range six, west of the Second Principal Meridian, and to construct and operate telegraph and telephone lines in connection with the said railway and coal company, and with power to buy, lease, acquire, sell and mortgage lands for coal mines, and to work such mines, and to sell the product of such mines, and generally with all powers, rights and privileges usually granted to railway companies under charters of incorporation.

La Compagnie des Mines d'or de Mattawa.—Notice is given that the above company has been incorporated under the laws of the Province of Quebec, to prospect and work gold, silver and other minerals in the said province. Head office, Joliette. Capital stock $24,000, in 2,400 shares of $10 each. Those incorporated are: E. Guilbault, A. Magnan, J. Rivard, J. H. Renaud, J. H. Ostigny, D. D'esormiers, all of Joliette, and J. Alderic Ouimet, Montreal.

The Templeton Asbestos Mining Company (Ltd.)—This company has been formed in London, Eng., with a capital of £25,390, in 2,500 ordinary shares of £10 each, and 390 founders' shares of £1 each, to acquire asbestos mines, mining rights and land likely to contain asbestos in the Province of Quebec, and to work the same. The number of directors shall not be less than three nor more than seven, and the qualification is £500. The first subscribers, taking five shares each, are:—R. Wissmann, Overhill Road, Dulwich; J. Werner, Richmond, asbestos merchant: C. R. Hammer, East India Avenue, London; E. Schwarte, East India Avenue, London; C. Keening, Creechurch Street, London; H. Meyer, Threadneedle street, London, banker; M. J. Richoff, Throgmorton street, London.

The West Kootenay Mining Co.—This company was registered under the laws of British Columbia, on the 23rd ult., for the purpose of purchasing and owning mines in Canada and the United States; the operating of smelting and reduction works; the buying and selling of bullion and other products, and generally to carry on a mining business in all its branches, with the customary powers. Term of existence, fifty years. Head office, Ainsworth, Kootenay Lake, B. C. Capital stock, $1,000,000 in 100,000 shares of $10.

The New Brunswick Mineral Developing Company.—Application will be made to the New Brunswick Legislature by the above company, for incorporation, to prospect for minerals, deal in mines and mining claims, operate mines and carry on a smelting and refining business. Head office, St. John, N.B. Capital stock, $50,000, in 5,000 shares of $10. Applicants, J. De Wolfe Spurr, G. W. Merritt, H. A. Drury, R. C. Elkin, B. G. Taylor, all of St. John, N.B. The three first named to be the first directors.

Ogema Mining and Smelting Co. of Thunder Bay (Ltd.)—This company, to which reference has before been made, has been incorporated under the Ontario Act.

The Belmont Bessemer Ore Company (Ltd.)—Application will be made to the Ontario Legislature by the above company for incorporation. The objects of the company are the prospecting, acquiring, etc., of mines, mineral and other lands in the Townships of Belmont and Methuen, Peterborough County; the Township of Marmora, Hastings County; and the Sudbury and Fairbank regions in the District of Algoma—more particularly Lot 19, 1st Concession, Township of Belmont; the opening up and working of mines in these districts, the erection and operation of smelting and refining works, and generally, the carrying on of mining in all its branches. Head office, Toronto. Capital stock, $600,000, in 6,000 shares of $100 each. Applicants, J. M. Ashley, jr., vice-president of the Toledo, Ann Harbor and North Mich. Railway, R. L. Major, W. A. Kissam and J. T. Sill, all of New York, and Edmund Bristol, Toronto; all of whom are to be the first directors.

Atlantic Stone Company.—This company is applying for incorporation, under the Nova Scotian Act, for power to open up and work stone quarries; sell the products, and for other customary powers. Head office, Lower Cove, Cumberland County, N. S. Applicants, A. Seaman, R. S. Hibbard and E. Q. Rowan. Solicitors, Townshend, Dickey & Myers, Amherst, N.S.

The MacGregor Lake Phosphate and Mining Company (Ltd.)—This company is applying for incorporation by the Dominion Parliament for the purposes of acquiring and holding mineral and other lands and mining rights, phosphate of lime and other ores, of selling, dealing in and disposing of the same, and of pulverizing and reducing the said minerals and ores, and manufacturing and dealing in the commercial products thereof, throughout Canada and in Great Britain. Head office, Montreal. Capital stock, $60,000 in 600 shares of $100 each. Applicants, Alexander Cross, Glasgow; J. R. Stewart, Glasgow; G. R. Smith, Buckingham, Que.; James Williamson and J. C. Smeaton, Montreal. The last three named to be provisional directors of the company.

The Liverpool Land and Improvement Company (Ltd.)—Application will be made to the British Columbia Legislature for the incorporation of the above company, to purchase, etc., lands, and among other things, to deal in ores of every description, and to make any improvements, etc., on said lands. Head office, New Westminster, B. C. Capital stock, $500,000, in 5,000 shares of $100 each. Applicants, John Hendry, B. Douglas, Henry Elliott, H. Hoy, E. S. Scoullar, all of New Westminster.

Richmond Slate Quarrying and Asbestos Company.—The first annual meeting of the shareholders of this company was held at Richmond on the 24th inst. The following gentlemen were elected directors: Messrs. Thomas Logan, J. C. Bedard, J. U. Messier, L. Jutras and J. N. Jones. Mr. Thomas Logan was elected president; Mr. J. C. Bedard, vice-president and managing director, and Mr. E. J. Bedard, secretary.

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	3⅜
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	⅜
Anglo-Canadian Asbestos, Limited, £11,500 fully-paid shares of £2	—	
Anglo-Canadian Phosphate, Limited, £46,510 fully-paid preference shares of £10	—	
Ditto, £25,000 fully-paid deferred shares of £10	—	
Bell's Asbestos, Limited. £140,000 fully-paid shares of £5	12⅜	12⅝
Ditto, £68,400 debentures, 5 per cent.; interest January 1 and July 1	—	
Canadian Phosphate, Limited, £100,000 fully-paid shares of £1	—	
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	—	
White's Asbestos, Limited, £20,000 fully-paid shares of £1	—	
Ditto, £15,000 shares of £1, with 15s. paid	—	

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, 3¾ 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 3¾ 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. Debentures, £3,450.

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. See meeting of company in this issue.

New Reduction Works.—The new reduction works at Rat Portage are now ready to commence operations, a number of minor parts of the machinery which were wanting having been made. Between 30 and 40 men will be employed, and the works will be in full blast before navigation opens. Ore from the mines around Port Arthur, now sent to the United States to be crushed, will be operated on, and the management is hopeful that the trade will rapidly increase. The capacity of the works is 50 tons of crude ore every 24 hours, which converted into concentrates would represent 800 tons daily, which would be the maximum output. This new industry will afford a living to about 5,000 souls in treating the ore, from its bed in the mines until after it passes through the reduction process.

Duties of Miners.—The statute books are full of mining laws, pushed through the legislatures of the coal or ore-producing States of the Union by political demagogues who have no conception of the subject which they champion, but who, for the sake of votes and political preferment, would use all their energies, if necessary, to secure the appointment of goats as guardians over asparagus beds. The majority of these mining laws dictate what the operator must do, but very little is to be found as to the duties of the miner—simply jug-handle enactments. What is the use of mining laws, called into existence by and through the influence of men who call themselves the representatives of miners, laws calculated to benefit them, the miners, if they pay no heed to the strict compliance therewith, as regards their personal safety? Many excellent regulations are laid down for the good government of mines, with a view to protect the lives of miners and assure them every possible safeguard, yet the very men who clamor to have these safeguards established, ignore them, and if one happens to catch a wrong-doer, and he is subjected in consequence to a lay-off for a few days, or, as the case may be, to discharge, a strike is very apt to result, unless the culprit is reinstated. It is practically impossible to obtain a miner's testimony against another miner, in cases of any violation of the regulations governing a mine, hence the great difficulty to prevent these oft recurring disasters.—*Black Diamond.*

IRON STEEL AND HEAVY METALS.

Iron and Steel.

Montreal, March 24th, 1891.—Notwithstanding the strong statistical position of the British pig iron market, the apparent firmness which displayed itself about the close of last month has given way to a general depression, and we have to report lower prices than have been current for some time past. Advices from Glasgow state that disgusted holders are selling out their warrants for pig iron, and rumors of financial troubles in London and discouraging reports about the general condition of the trade are for the moment preventing any fresh buyers coming on. Scotch warrants, which were selling about 46s, at the beginning of the month, have touched as low as 43s. 4d., which is their present figure. It is evident, however, that any signs of even a partial revival of trade would bring about an immediate re-action, as stocks in Scotland are still being decreased at the rate of 4,000 to 5,000 tons per week, which must sooner or later have a very steadying effect on the market.

The arrangement by which a few of the furnaces in Scotland were to be blown in has gone into effect, and about one-third of the total number are now in operation with non-union men. All the shipping brands, such as "Coltness," "Summerlee," "Calder," "Langloan," "Gartsherrie," "Carnbrae," "Govan," etc., are now to be had, and the fears of a scarcity of these irons for spring trade are now happily dispelled.

Prices for stock iron continue about the same, and a fair quantity of "Summerlee" has moved out during the month at prices ranging from $23 to $23.50 ex-store Montreal, while a good business has been done in some of the lower grades such as "Carnbrae" and "Eglinton," at about $1.50 to $2 less. Stocks in Montreal are not excessive, and it is fully anticipated that they will all be required before the opening of navigation, as buyers did not lay in any considerable quantity in the fall, and are now beginning to run short. For the spring trade it is expected that prices will be low enough to compete favorably with American irons, not only in Montreal but also in the West. It is anticipated, however, that the demand will not be very large in the early part of the season, owing to the rather unsatisfactory condition of the agricultural implement trade. Manufacturers of these machines are proceeding very cautiously, and do not care to manufacture largely until they are assured of a more satisfactory state of affairs than last season. This business, however, is in very strong hands, as the smaller manufacturers have been gradually absorbed by the larger ones, and these are well able to bear any temporary strain.

In connection with the introduction of American pig iron into Western Canada, it is worthy of notice that it has caused iron founders to pay more attention to their mixtures, and to the analysis of the irons they use, than they have done before. In the United States almost all pig iron is sold according to analysis, while the various Scotch brands which have been used in Canada vary so little that they have been used from year to year without any enquiry as to their analysis. It is well to note, however, that the Scotch furnaces are quite as far ahead as the American, and their manufacture is conducted with as much attention to this point as in any blast furnace on this side of the Atlantic.

Finished irons are also slightly easier than they were a month ago, and we understand that Canadian iron is now being sold at $2.10 to $2.15 per 100 lbs. in Montreal, while English bars are quoted $2.25 to $2.30. It is only, however, for special work that the latter are brought in, and only the finer brands are wanted for this.

The demand for tin plates continues, although the works in South Wales are now fully loaded up with orders for shipment before the new American tariff comes into operation. Consumers in Canada are buying only what they actually require for their immediate wants, as there is no doubt that they will be able to do better for shipment after the month of June than can be done at present. Coke tin plates are quoted at $4.50 to $4.75 in Montreal, while charcoals range from $4.75 up to $5.50 according to quality.

Makers have not begun to make any Canada plates yet, but they will start at this work immediately after the demand for tin plates is satisfied, as both these articles are made by the same people.

No change of any importance has taken place in the other departments of this trade, and copper, tin, zinc, etc., remain unchanged.

London, March 15, 1891.—The general position is very quiet, and all the current indications seem to point to a more irregular demand, a gradual lowering of selling prices, and the inevitable reduction of wages and fuel. All these forces are already in operation, not only in Great Britain but also in every iron making country of the world; hence they must be recognized as being the natural sequence of the recent period of abnormal activity. Labour has received several severe checks in regard to the more arrogant pretensions of the trade-union leaders, and it is destined to retreat many points before circumstances again place it in a position to dictate to Capital. The blast-furnacemen in Scotland, for instance, have been completely defeated, and have not only failed to secure extra pay, but are resuming work at a 20 per cent. reduction. There are now twenty furnaces at work in Scotland, and more will be restarted almost immediately, so that the output of Scotch pig will be enlarged, and a check put upon the importations into Scotland from Middlesborough. Warrants are declining in value somewhat considerably, and the odds are that they will go several shillings lower before a state of equilibrium is reached—particularly if the reserve stocks should be increased. At present Connal's Glasgow stores contain 542,000 tons, as against 857,254 a year ago and 1,032,922 tons in 1889. All warrants are neglected, and the general demand for pig iron is dull. Buyers are holding back for rather lower prices, as they are enabled to do, owing to the quietude of the demand for their own productions. The call for many kinds of machinery, implements, and ironwork is still good, nevertheless; but merchant iron is slow, and the outlook is not brilliant. There is a softening of fuel prices, but there is yet room for a much more marked fall.

Liverpool, March 15, 1891.—There is a slight improvement in the tin-plate market here, there being a better demand and greater disposition on the part of both buyers and sellers to come to business. Bessemer steel cokes are again saleable at 17s. 6d. (Wales), and there are numerous buyers offering 17s. 3d. and 17s. 4½d., but no sellers at these figures at present. The improved demand has been chiefly for Bessemer and Siemens steel coke tins, and to a limited extent also for charcoal tin-plates, but there is still nothing doing in terne plates, and What has become of the orders for these? is a question that is exercising a great many peoples' minds just now. Bessemer tins now range in price from 17s 6d. to 18s. I C Wales; Siemens-Martin steel cokes, 18s. to 19s. I C; charcoal tin-plates, 19s. to 21s. 6d.; best charcoal tin-plates, 22s. to 24s. I C; terne plates, 31s. 6d. to 36s. The exports last month were 32,895 tons, as compared with 24,566 tons during the corresponding month of last year, and 33,971 tons during the same month of the previous year. For the first two months of this year the quantity exported was 72,322 tons, as compared with 56,734 tons during the corresponding period of last year, and 71,649 tons during a similar period of the previous year. The stocks in this country on the 1st inst. were 483,476 boxes, as compared with 498,164 boxes on the 1st ult., or a decrease of 14,688 boxes. Tin £90 5s. to £90 10s. Scotch pigs 45s. 4d. to 45s. 6d. The shipments last week were 2,835 tons, as compared with 6,606 tons during the corresponding week of last year. Middlesborough, 40s. 7d. to 40s. 9d.; hematites, 49s. 6d. to 49s. 9d.

Scotch Pig Iron Warrant Market.—Below is given our usual table of the position of the warrant market:—

Scotland.

	1891.	1890.	1889.	1888.	1887.
Price of Scotch warrants, Mar. 10	45/4½	50/5	43/11	38/10½	43/3
Furnaces in blast in Scotland, Mar. 10	20	89	81	85	71
Quantity of iron in public stores	542222	857254	1032942	956811	850201
Shipments of Scotch pig iron for week ending Mar. 7	2880	6822	6138	6769	10690
Do. since beginning of year	38093	69783	75622	66790	80102
Middlesboro iron imported at Grangemouth, week ending Mar 7	10620	2650	7361	6785	4315
Do. since beginning of year	66090	27034	72828	68315	62798

Cleveland.

Price of Middlesbro' No. 3, warrants on Mar. 10	40/7½	50/-	37/-	31/3	35/-
Furnaces in blast in Middlesbro' district	97	106	99	96	90
Quantity of iron in public stores*	128088	172521	255312	334407	321532
Shipments of pig iron from Middlesbro' for week ending Mar. 7	16700	11383	19651	16730	16521
Do. since beginning of year	135098	99523	156841	155135	128152

West Cumberland and North Lancashire.

Price of hematite M/Nos. warrants	49/7	63/-	47/1	41/10½	45/6
Furnaces in blast in W. Cumberland and N. Lancashire	40	55	45	48	52
Quantity of iron in public stores†	197876	373445	437687	428470	300765
Shipment of hematite iron for week ending Mar. 7	12010	8035	9197	7643	14594
Do. since beginning of year	82324	104919	93936	92480	98816

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

New York, March 24, 1891.—There has been nothing of particular moment to note in the general position of prices, or in the volume of business doing, for some little time. The buying is of a very hand-to-mouth character, buyers being contented to fill their immediate wants only. Perhaps on the whole, there has been a better feeling evinced of late, but the market is decidedly dull. Prices continue firm, and there are no reports of any concessions being made. This feeling is of course due to the less pressure to sell, since the reduction in stocks of iron has become pronounced; and the market is in a measure relieved of that incubus hanging over it. The coke strike still continues, although late dispatches from the Connellsville region indicate that it is weakening, and that an early settlement may be effected. That this has had no more influence is an evidence of the overstocked condition in which the iron market has been. Dealers report somewhat more inquiry for American pig iron, but no increase in orders, and the market is inactive. Prices are held firmly, and no shading on any brands is reported. The scarcity of No. 1 Southern iron is still pronounced, and dealers are unable to fill orders. No. 2 Southern iron is offering rather more freely. We quote Northern No. 1 X, $17.50@$18; Northern No. 2 X, $16.50@$17; Southern No 1 X, $17.50@$18; Southern No. 2 X, $16.50@$17. There has been very little doing in spiegeleisen and ferro-manganese, and the transactions have been limited. Prices of ferro-manganese, however, are a little firmer on account of the rise abroad. We quote, nominally: 20% spiegeleisen, $28.50@$29; 80% ferro-manganese, $63.50 @$64.50.

Cleveland, O., March 23, 1891.—The market has been dull for some weeks past, with very little movement. The price of pig iron still keeps down, although there is an actual scarcity of raw material. The reason for this state is found, to a large extent, in the falling-off, among the consumers, of orders, which, it was thought, would be forthcoming early in the spring, but which are still being withheld. Bessemer iron and a high-grade, all-ore foundry (No. 1) sell at about $17 at the furnace, where, indeed, there is any for sale. In the lines of manufactured iron there is very little that is encouraging. Bar iron is selling at $1.65 in large lots, and even that is an improvement, as but a short time ago a lot was sold at $1.57½. Sheets are also a trifle weak, but no more so than is usually the case at this time of the year. No. 24 is held at, say, $2.75, and No. 27 is worth fifteen cents more. In all the other lines there is but little activity, save in the combination makes, which are held up pretty stiffly to the full price.

Copper.—At length there has been a stiffening in copper in the American copper market on all grades. The second-hand offers of Lake copper have almost entirely disappeared, and it is questionable if anything can be obtained below 14c., at which price the Lake companies remain sellers. Arizona copper is exceedingly scarce. Pig copper is almost unobtainable for spot or near delivery, as large quantities have lately been shipped for export. Arizona ingot copper is held for 12¾c@13c. Casting copper is also firmer. Small consumers have lately been able to purchase at about 11¼c in New York, but later on at this price pretty heavy transactions took place in the different brands, and now a firmer tendency prevails and we hardly think that anything is obtainable now below 11¾c@11¾c. The deliveries have been heavier in the last few days than for some months.

Lead.—Lead has been strong in the States, and a good business has been done at firm prices. Stocks appear to be small everywhere, and, with the demand at this time of the season becoming larger, it may reasonably be expected that prices will harden. New York quotations are: 4¾c@4.40c. for near deliveries, but future deliveries are rather firmer and not obtainable below 4.45@4.50c.

The London market has been steady at £12 12s. 6d. for Spanish and £12 15s. for English.

At St. Louis, lead is firmer and a shade high; 4.12½c. has been paid for a few special lots. Offerings are moderate, and the demand is slightly improving.

The Influence of Low Temperatures on Steel.—

The results of certain experiments in relation to the effects produced on steel by very low temperatures have been recently published by order of the French Minister of War. The experiments were undertaken to determine (1) the value of the co-efficients of dilatation of steel hardened and unhardened at low temperatures, and (2) the effect produced by very low temperatures on the strength of steel. It was observed that the difference of dilatation decreased very rapidly when the temperature fell below —30° Centigrade, tended towards zero between —100° and 150° Centigrade, and were scarcely appreciable beyond—200°. As to the effect of great cold upon the tensile strength of steel, it was concluded that the elastic limit and the charge of rupture both increase with the low temperature, for tempered as well as for untempered steel, that the elongation decreases with the temperature, and that the striction also diminishes with the

temperature. It was deduced from the tests that steel sustains no permanent damage from subjection to severe colds. As to the effects of very low temperatures in respect of the resistance to transverse shock, the conclusions arrived at were:—(1) The fragility of the steel increases as the temperature decreases. The untempered bars withstood, on an average, 14·6 blows at ordinary temperature, and 5·9 blows at the low temperature. The tempered bars withstood, on an average, 17 blows at ordinary temperature, and 12.6 at the low temperature. (2) A comparison between the tempered and untempered bars shows that under the action of the cold the fragility of the untempered bars increases in a large proportion. (3) The stiffness increases as the temperature diminishes. The broad results of the experiments are set forth in the following terms:—Under the influence of severe cold the molecular state of steel is modified temporarily as follows:—The elastic limit, the breaking load, the hardness and the stiffness increase as the temperature diminishes, the fragility under shock also increases, and the elongation decreases. These modifications have not a permanent character, and the metal returns to its original state under the ordinary temperature.

The cost of making Tin-plates.—According to a "Retired Ironmaster," who says he has followed the course of the tin-plate industry in England and America for the last twenty years, tin-plates could be profitably made even now in the United States. He gives the following figures as to the prime cost:

Calculation showing at what cost tin-plates can be manufactured at various points in the United States.

2,240 lbs. of steel billets, freight paid		$26.00
5 per cent. waste in heating the same		1.30
7 per cent. crop-ends	$1.82	
Less available scrap	1.40	
		0.42
Labor in bar-mill, heating and rolling		2.25
Fuel (coal at 1.25 per ton)		0.75
2,240 lbs. tin-plate bar		$30.72
Sheet scrap, 15 per cent	$1.68	
Less available scrap	1.53	
		3.11
Tonnage labor in sheet-mill, Amalgamated Association rates		14.40
Total		$48.23
60 lbs. acid for black pickling at 1½c.		0.90
Waste in pickling, 2 per cent		0.97
Pickler, per ton		1.50
Annealer, per ton		1.00
Fuel for sheet-mill and annealing (1 ton coal)		1.25
Cold-rolling (smoothing plates)		1.00
Total		$54.85
Wear and tear, repairs and maintenance		3.50
Day labor and salaries		9.50
Current and incidental expenses		3.00
2,240 lbs. black plate ready for tinning		$70.85
(Cost per lb. 3.16c.)		

Hence the following estimate of the cost of one box of tinned plate:—

100 lbs. of I.C. short-weight plates per box	$3.16
2 lbs. acid for white pickling at 1½c	0.03
Pickler's wages	0.08
1 lb. palm oil	0.06
2 lbs. flux (muriatic acid and zinc) at 2 c	0.04
2½ lbs. pig tin at 21c	0.53
Bran or middlings	0.03
Tin-house labor	0.30
Fuel	0.03
Incidentals	0.10
Box	0.12
Loss on one box wasted out of every ten = $1	0.10
Total	$4.58
10 per cent. profit added	0.46
Average freight to market	0.25
Cost of one box of coke tin	$5.29

This is the cost, he says, of plates about equal to Penlan grade, which is now quoted at New York at $5.40. For plates equal to Melyn the cost is put down at $6.25. He estimates that it would cost about $160,000 to build and equip the works necessary to produce the plates, and on a production of 65,000 boxes a year he figures out that the profits ought to be $32,500 per annum, at an average gain of 50c. per box. In connection with this subject it may be of interest to look at the following statement of the cost of making good common sheet iron of No. 27 gauge at the American works:—

2,240 lbs. muck bar		$27.00
7 per cent. waste in reheating		1.89
7 per cent. crop-ends	$ 1.89	
Less available scrap	1.40	
		0.49
Bar-mill labour		2.25
Fuel		0.75
Cost of 2,240 lbs. finished sheet bar		$32.38
15 per cent. scrap in sheet-mill	$ 4.86	
Available at	1.50	
		3.36
Sheet-mill labour, per ton		10.30
Annealing		1.00
Fuel for mill and annealing		1.25
Total		$48.29
Repairs and manufacturing expenses		3.00
Day labour and salaries		8.50
Current and incidental expenses		3.00
Cost of 2,240 lbs. No. 27 gauge		$62.79

This is equal to about £12 11s. per ton, or a good deal more than the equivalent prime costs in England.

Wages of Scotch Furnacemen.—The following are the rates of furnacemen in Govan Ironworks, Scotland:—Hematite brands—Keepers (in charge of furnace), 4½d per ton; shift wages, 5s 10d; assistants, 3½d per ton; shift wages, 4s 6d; fillers, 4¾d for Nos. 1, 2 and 3 brands, 4½d for No. 4 brand; shift wages, 5s 6d; pig lifters, 5¼d per ton, with no shift wages. Ordinary brands—Keepers, for No. 1 brand 5½d, for No. 3 brand 3⅞d; shift wages, 5s 6d; assistants, for No. 1 brand 3⅝d, for No. 3 brand 2⅝d; shift wages, 3s 10d; fillers, for No. 1 brand 4⅞d, for No. 3 brand 3⅞d; shift wages, 5s 1d; pig lifters' shift wages, 5s 1d; scale men, 4s 7d. The masters also make an all round deduction of 7½ per cent. for sand, and when selling off allow 2½ per cent., being a general deduction of the above rates of 5 per cent. Dixon's furnace men state that these rates are from 5 to 10 per cent. lower than those allowed at Coltness.

The Basic Process as Applied to Copper Smelting.

At a meeting of the English Society of Chemical Industry, Mr. Percy C. Gilchrist read a paper on basic copper smelting. Arguing from the great advantages which ensue from the replacement of the ordinary siliceous linings of steel smelting furnaces by a lining composed of basic material, when phosphoric pig iron has to be converted, the author thought it might reasonably be expected that the substitution of a basic lining for the siliceous lining hitherto employed in copper smelting furnaces should also be followed by similarly advantageous results, especially when the cupriferous material to be treated contains any notable percentage of arsenic or antimony.

In the case of steel manufacture, the result aimed at in substituting a basic lining for the acid was well defined—viz., the removal of phosphorus, a problem incapable of solution in acid lined furnaces, owing to the acid nature of the slags necessarily formed with such linings, but which was readily accomplished so soon as the presence of a basic lining in the furnace allowed of a basic slag being formed and maintained. No such direct improvement, however, was to be looked for in the case of copper smelting, as the only deleterious element occuring with any frequency in crude copper, viz., arsenic, can be very perfectly eliminated in the acid lining at present made use of. A careful study, however, of the composition of copper roaster and refinery slag reveals the fact that, unlike steel slags from acid practice, the copper slags formed during the removal of the arsenic are basic and not acid in character, the basicity being chiefly due to the presence of copper oxide in quantity more than sufficient to neutralise the silica, which latter, in the roaster and refinery furnace, originates almost wholly from the sand or clay used to form the furnace bath. Lime or lime and soda ash are used very generally in the ordinary sand lined refinery, but the quantity which can be added without detriment to the lining is not large, and does not compensate for the large amount of siliceous material which is dissolved away from the sides of the furnace. It was therefore rather in the direction of lessened oxidation, and therefore in-

creased yield, that the author expected improved results by the use of basic linings and more calcareous slags in copper smelting.

In May, 1889, the technical adviser of one of the largest copper-smelting companies was exceedingly anxious to make a trial of a basic lining in one of their roaster furnaces. This lining was accordingly put in and is still in perfect condition. The results obtained with this first lining were so satisfactory that at the present time the company have nine roaster furnaces at work treating arsenical "metallic bottoms" and white metal. As the old roaster furnaces require renewing, they are being rebuilt with basic hearths, so that, shortly, probably all the roaster furnaces employed at these works will be furnished with basic linings. These roaster furnaces have cast-iron bottom plates, underneath which a free current of air circulates; by this means the bottom of the furnace is kept cool, it likewise prevents the possibility of any fusing action taking place between the basic hearth and its support, which might be the case were the basic hearth built directly upon the ordinary silica arch. The basic material is ground and mixed with tar in the usual way, and the furnace bottom is formed by throwing this material into the hot furnace and burning it on in layers, well beating down each separate layer and giving it fire for some hours before applying a fresh layer. It usually takes four or five days to burn on a bottom in this way. When the bottom is properly shaped it should be seasoned by melting on it some rich copper precipitate or good blister copper. It was at first considered that the basic hearth absorbed less copper than the ordinary sand ones, but there appears to be very little, if any, difference between them, much depending on the way the bottom is formed and seasoned. The tap-hole of the furnace is shut by throwing a little basic material against it from the inside. In other respects, the working of the furnace is conducted in the usual way. After each charge any slight repairs that the banks may require are made by throwing some basic material against the place needing repair; the repairs required are, however, very slight in comparison with an acid furnace, the tendency being for the furnace banks to grow rather than to cut away.

The mineral in use at these works is arsenical, and although in the crude ore the arsenic is not high, yet when the ore is allowed to oxidise in heaps and the copper afterwards precipitated from the solution, obtained by lixiviating the ore, arsenic is concentrated in the precipitated copper to a considerable extent, the resulting precipitate usually containing some 3 to 3½ per cent. of arsenic. Very large quantities of this precipitate are treated. It is added to the mixture of slag and metal charged into the smelting furnace, and according to the amount of precipitate so added to the charge, more or less of the product tapped from the smelter consists of impure copper, known as "metallic bottoms." An average analysis of these bottoms gives:—Copper 83 to 87 per cent.; arsenic, 5 to 7; sulphur, 1 to 3; iron, 0·5; lead, 3 to 5; silica, 0·5. It is in the conversion of these metallic bottoms into blister copper containing under 1 per cent. of arsenic that the basic furnaces have shown themselves to the greatest advantage. Calculations show that taking the real copper in the "metallic bottoms" at 84·5 per cent., and the real copper in blister at 98·5 per cent., there was obtained in the form of blister 94 per cent. of the real copper from the basic furnace and 56 per cent. of the real copper from the acid furnace, showing a gain of 38 per cent. in favour of the basic furnace. The real copper in the slag works out to 25 tons 14 cwt. from the basic furnace, and 121 tons 19 cwt. from the acid furnace.

In addition to the largely-increased yield of blister obtained from the basic furnace over the sand-lined furnace when treating metallic bottoms, there is a further advantage, viz., that these metallic bottoms have a most deleterious effect upon the sand lining of the furnaces, the bottom nearly always requiring repair after three or four days' working.

After carefully investigating the results obtained from the substitution of a basic lining in the roaster furnace for the ordinary sand lining, it was resolved to test whether any substantial improvement resulted from a similar change in the refinery furnace. The margin for improvement in the case of the refinery furnace is far less than in the case of the roaster furnace process; it is therefore still a little uncertain whether the extra cost of the initial basic lining and of the current repairs are compensated for by the slightly increased yield, when making ordinary tough cake. When, however, it is a question, not of making ordinary tough cake, but of producing best selected copper from ordinary arsenical blister (containing about 1 per cent. of arsenic) there is, in the author's opinion, a very great saving in waste effected by the use of a basic lining in the refining furnace.

The basic refinery has so far been used chiefly for the production of best selected copper from B. S. precipitate only, or from pure blister containing only some ·2 to ·3 per cent. of arsenic, but some charges have recently been made from blister containing 1 per cent., and which have been worked down into B. S. ingots with very good results as regards yield, but as might naturally be expected, longer time is required.

Summing up, therefore, the results so far obtained in basic copper smelting, it would seem that where the basic process has shown itself to be of most use is in the treatment of highly arsenical material tapped from the smelting furnaces. Such material, being produced from the poorer arsenical precipitates, generally gives a great deal of trouble in the ordinary way of working, with a very high loss of copper in the slags, which necessitates extra labor and expense to rework. Another very important point to which the basic process shows itself well adapted is in the refining of blister rather high in arsenic (say from 1 to 1½ per cent. or higher) for the purpose of making B.S. ingots.