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CANADIAN MINING & MECHANICAL REVIEW

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

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THE OFFICIAL ORGAN

—OF—

THE GOLD MINER'S ASSOCIATION OF NOVA SCOTIA.

THE UNITED MINING SOCIETY OF NOVA SCOTIA.

THE ASBESTOS CLUB, QUEBEC.

THE GENERL MINING SSOCIATION OF QUEELC

THE following Resolutions of Council indicate beyond a peradventure the status of THE REVIEW as the exponent of the Canadian Mineral Industries:—

The Gold Miners' Association of Nova Scotia.

"At the annual meeting of the Gold Miners Association of Nova Scotia, held at Halifax on 6th March, 1889, THE CANADIAN MINING REVIEW was adopted the official organ of this Association.

(Signed), B. C. WILSON, *President.*
G. J. PARTINGTON, *Secretary.*

The Mining Society of Nova Scotia.

"Moved by Mr. R. G. Leckie, seconded by Mr. C. A. Dimock, That the thanks of the Society be tendered to Mr. B. T. A. Bell for his kind offer placing the columns of THE REVIEW at the disposal of the Society; and that THE CANADIAN MINING REVIEW is hereby appointed the official organ of the Society."

(Signed), H. S. POOLE, *President,*
H. M. WILDE, *Secretary.*

The Asbestos Club, (Quebec.)

"Resolved: That THE CANADIAN MINING REVIEW is, by authority of the Members and Council, hereby appointed the official organ of the Asbestos Club."

(Signed), D. A. BROWN, *President.*
A. M. EVANS, *Secretary.*

The General Mining Association of the Province of Quebec.

At a meeting of Council held at Montreal on Friday, 6th May, 1891, it was moved by Captain Adams, seconded by Mr. R. T. Hopper, and resolved: That THE CANADIAN MINING REVIEW be the official organ of the Association.

(Signed), GEORGE IRVINE, *President.*
B. T. A. BELL, *Secretary.*"

The late Mr. W. H. Irwin.

It is our painful duty to record this month the death of Mr. W. H. Irwin, which occurred at his residence in Montreal, on Sunday, October 1st. The deceased gentleman was a partner in the well-known firm of Irwin, Hopper & Co., dealers in asbestos, and at the time of his death was a director of the Anglo-Canadian Asbestos Co. (Limited), the Montreal and Kootenay Mining Company (Limited), and the English Portland Cement Company (Limited). To the mining men of the Province of Quebec, he will be long remembered for the prominent position he took in all that affected the welfare of the industry, and particularly for the energy and zeal he displayed in promoting the abolition of Mr. Mercier's obnoxious mining law, the tax on powder magazines, and other legislative measures. He was one of the first to advocate and further the formation of the General Mining Association of Quebec, and by his untimely death the members of that body mourn the loss of a wise counsellor and firm friend. He took an active part in the proceedings of the International Mining Convention at Montreal in February last, being foremost in promoting and carrying out the arrangements for that meeting and in entertaining the visitors. Indeed, we are informed that his death is directly traceable to this event, for a cold contracted on the toboggan slides with a party of guests developed into an attack of pleurisy from which he never recovered.

The deceased gentleman, who was only 38 years of age, married about twelve years ago a daughter of the late Mr. Johnson, Assistant Commissioner of Crown Lands for the Province of Ontario, by whom, with one daughter, he is survived. The REVIEW joins with every member of the General Mining Association of the Province of Quebec, and the mining men of the country, in tendering to Mrs. Irwin an expression of sincere sympathy in her sore bereavement.

The late Mr. W. Hall Irwin.

Bimetallism — Rothwell's International Monetary Clearing House a Chimera.

The fundamental condition underlying any attempt to create a double standard of value, is the possibility of maintaining an exactly equal value for given quantities of two separate metals, that is, that an ounce of gold shall always be equivalent to a certain number of ounces of silver in the denominations by which money is known; in such a way that whoever has a payment to make or a debt to receive, it shall be a matter of absolute indifference whether he gives and receives this in gold or silver (or in paper certificates of either, or paper promises to pay either).

It need not be stated that the actual unit of value in every country is a certain definite weight of metal. It is important that this should be clearly understood, and that this has come to be so through the varying influences operating for many centuries in the region of commerce and banking; for the all dominating reason that while the *value* of anything is a fluctuating and uncertain quantity affected by many influences constantly working in millions of minds and finally resulting in what is called "supply and demand," the *weight* of any commodity that can be handled is a fixed and determinate thing. Not all the influences in the world put together can make an ounce of silver more than an ounce, or a pound of copper more than a pound. There are fixed standards of weight in every country, by whatever names these weights may be known. These are capable of being made so definite as to be absolutely unalterable. Similarly with anything that is estimated by its bulk, any commodities that can be *measured* are susceptible of definition that is absolutely unalterable. An inch, a foot, a yard, are certain properties of matter which are determined by unvarying and invariable standards, and no conceivable circumstances can make any change in them. No law of supply and demand has the slightest effect upon the length of a piece of cloth, or the weight of a bar of iron, or of an ingot of gold or silver. When, therefore, contracts are made to buy or sell so many tons of iron or so many yards of cloth, the quantity can be exactly estimated inasmuch as their denominations must conform to fixed standards in possession of the government of the country. Weight on the one hand, length, breadth or thickness on the other are properties inherent in material bodies, and nothing can alter them.

Now, these weights and measures, so far as the denominations are concerned, are purely arbitrary as between one country and another; yet, within the same country they must perforce be precisely the same. Every country has somewhere a legal standard of length, and a legal standard of weight, and these are purely matters of legislation. The legislature of any country, if it so pleased, could make its standard of a foot to be six inches longer, it could make an inch equivalent to two inches, it could make a yard as long as a yard and a half. But then this standard would require to be universally adopted and understood throughout the country, or the whole of its exchanging or trading operations would be thrown into confusion, and it would require to make known its standard to other nations of the world, or its trade with them would be thrown into disorder. In practice, such things as attempting to alter measures or weights and make them longer or shorter, heavier or lighter, is unknown, for no possible object would be attained by it to anybody.

But when we enter upon the region of *value*, we are in a world of ideas of an altogether different kind—for value is not inherent in anything whatever. Value is in the mind of man—it is a purely mental conception—it does not inhere or form part of the substance of the thing itself. A bar of iron can be measured, and its length, breadth and thickness are unalterable—it can be weighed, and its weight is unalterable. A bar of silver can be subjected to the same process, so can a nugget of gold. But the value of that bar of iron is a mental conception, and that mental conception is subject to a thousand changeable influences. It may be one thing in one man's mind and another thing in another's—in fact, this changeable conception and the difference

between one man's mind and another man's mind is the foundation of all the bargaining and higgling that takes place in trade. This mental conception, too, may be different to-morrow from what it is to-day, and different as between different individuals. A man's mental conception may be different from that of yesterday in one direction, while another's may be different in the opposite direction. The play of all these divers influences is expressed by the varying figures that (like a thermometer) measure the heat or cold of the market, the desire or absence of desire of persons to get or to part with any commodity, ranging from the utmost eagerness to get, to the utmost eagerness to get rid of – midway beet. which is a state of perfect indifference. All these influences are operating every day with regard to every commodity that is used by mankind, and operating all over the world in tens of thousands of minds, giving rise to tens of thousands of conflicting thoughts, which finally settle themselves in the markets of the world, in certain figures which are called prices, which prices are just the final result day by day of thousands of conflicting mental conceptions. It would be vain to attempt to arrest this process as carried on day by day all over the world, that is to say, it would be utterly futile to attempt to fix a permanent exchangeable value for any commodity in existence.

It is here we touch that very interesting old problem of the limitation of legislative power.

The legislature of any given country has the power to regulate Weights and Measures, but if any Government were to attempt to regulate the *value* of any material commodity that can be weighed and measured, it would find itself baffled by the varying operations of these mental conceptions in the minds of men, arising out of changing circumstances of the world from day to day.

Let us illustrate. The Congress of the United States could, undoubtedly, pass an Act that a bushel should be larger or smaller than the standard bushel now in use, and when this was universally known, everything within the United States would adapt itself to the change But if Congress were to follow up this by decreeing that everywhere throughout its jurisdiction, a bushel of wheat should be exchangeable for a dollar, what would ensue? (We must carry out our illustration and suppose this law in effect for several years in which changing circumstances and elements come into play) There might be a time, and we will suppose that that time coincides with the passing of the Act, when in the produce exchanges of the United States the higgling and bargaining between the man who wanted wheat, and the man who wanted to part with it, had settled into a quotation of a dollar for a bushel. But the quantity of wheat in the world is constantly changing an enormous quantity is consumed every day, and an enormous quantity of new growth is taking place every day. It is upon men's calculations and opinions of the operations of these two forces that the price in the open market is determined. Now, let us suppose, (and such things do happen, it is not mere fanciful supposition) that the course of growth which finally results in harvest, is of such a character that the world has a very large supply. Those who have the commodity in the United States, find that the Government has established, that they can exchange every bushel of it for one dollar. So far, so good. But no bargain can be concluded without the intervention of two persons. There must be a buyer, as well as a seller, and in the mind of the buyer there will arise the conception that this quantity of the wheat is not worth a dollar, seeing that an equal quantity can be purchased abroad for less than a dollar. The man who has the dollar will send it to another country, and the commodity will be brought in in the course of trade. But the man who has the wheat wants money in exchange for it—his want is money, his demand is for money; in fact, he must have money in order to live. The exchange of his wheat is a matter of life and death to him. He will, therefore, under the operation of that necessity which knows no law, undoubtedly, part with his wheat for less than a dollar. On the other hand, if the process of growth results in a small crop, those who have wheat will find that persons who have money are very eager to get their wheat, and are ready to part with more than a dollar for a bushel of it. They would, in that case, undoubtedly, refuse to sell for a dollar, and as the eagerness of the buyer increased, it is certain the barriers of law would be broken down by the necessity of things. Unless, therefore, the law were to go so far as to impose penalties for every bargain that did not conform to its requirements, and unless the United States closed its ports to the whole outside world, for commodities whose value was fixed by law, it would be impossible for a single day to maintain a fixity of value. But these suppositions are both of them an absurdity. Any absolute monarch that made such decrees would be dethroned, and any legislature would be turned out.

Exchangeable value, then, cannot be determined by the action of a legislature without such further arbitrary and despotical conditions as would put an end to the legislature itself. In fact, it may be set down as an axiom that no action of any government has power to maintain the exchangeable value of any existing commodity. To this it may be replied that the government of England has done this very thing which is declared to be impossible; namely, it has fixed the value of an ounce of gold at a certain sum expressed in sterling figures.

But it will be obvious, in considering this matter carefully, and looking beneath the surface, that what the government of England has done in reality is simply to *determine the weight of the coin* which represents the pound sterling. This coin is called a sovereign, and consists of a definite weight of gold, very nearly a quarter of an ounce. The government stamp on this piece of gold is a warrant to the holder that the metal is genuine and that it is of a certain weight, nearly a quarter of an ounce. The value of an ounce of gold is fixed by law at £3 17s. 10½d. It will be obvious that so far as the gold is concerned, any sale, so called, is simply the exchange of a lump of gold of a certain weight, *for the coins that can be made out of it*, and is no proper exchange at all. But with regard to the shillings and pence, it may be contended that here is a *bona fide* exchange of one metal for another metal in such a way as to fix a relative price between the two. By the same law which ordains that an ounce of gold shall always be worth a certain sum of silver, it is ordained that twenty pieces of silver of a certain definite weight and with certain government stamps, shall be equivalent to a pound sterling. Here, it may be contended, is a genuine and perfect example of two metals passing current side by side, whereof a definite weight of one bears a definite relation of value to a definite weight of the other. This argument however plausible though it be will not stand the test of examination. For these silver coins, whereof twenty are declared to be equivalent to a certain weight of gold, are only allowed by law to pass current at that value in the shape of pocket money. As much silver as a man can conveniently carry in his pocket, viz., £2 worth, and with which he can make the small purchases of life, is allowed to be current at a definite value as compared with gold. This so-called value is purely arbitrary and limited. There the legislature has stopped, and has stopped by force of circumstances. No man can gather up a quantity of these silver coins exceeding £2 in value, and demand gold in exchange for them at the fixed ratio. Any man in England can buy one pound's worth of an article or pay a debt of £1, either with the gold sovereign or with twenty silver shillings; and he can go to the extent of £2 in this direction, but no further. He could not discharge any debt deserving to be called a commercial debt with silver. The law does not allow it. The Bank of England could not give one hundred of these silver coins in exchange for one of its promises to pay £5, and there are no smaller notes current in England. The law allows none of the operations of commerce to be carried on on a silver basis, still less the operations of banking. *The silver coin is nothing but a silver token*, and the fluctuations as measured in gold in the value of the metal, large as they are, do no harm whatever when the coins are restricted in their exchangeable value to such minute quantities. The same argument holds with regard to copper coins.

The silver shilling, then, being considered arbitrarily as a definite proportion of a single pound, which is a piece of gold, it becomes quite clear that the selling of an ounce of gold at the standard price fixed by law, is simply the exchange of a piece of gold of a certain weight, for three or four other pieces of an equal weight, with the government stamp affixed to them, that is, it is an exchange of gold for gold, which is not a commercial operation at all, and has nothing whatever to do with value. *A* has a bar of gold weighing one hundred ounces, *B* has a number of sovereigns weighing one hundred ounces. It is certain that *A* would not exchange

his bar of gold for *B's* separate pieces unless *B's* pieces were of equal weight with his bar, or so nearly that the difference in weight would simply represent the cost of melting the bar and coining it into the pieces requisite, and putting the government stamp on them. These operations are going on every day at the Royal mint and at other mints of the world. A gold bar can be changed into an equivalent weight of coins, coins can be transmuted into an equivalent weight of gold bar, and in these operations there is no question of a greater or lesser *price*, or increase or decrease of value, but simply of the cost of turning the weight of metal out of one form into the other, or *vice versa*; and the standard price is merely a way of expressing that the pound sterling shall always consist of a definite weight of gold, no more and no less, for which weight the holder of the piece of gold called a sovereign has the certificate of the government stamped upon it. If any person therefore says that the value of gold is this, that, or the other, as measured in gold, such language is meaningless. To say that a sovereign is worth a sovereign, or that £5 are worth £5, is mere nonsense. And it is equally meaningless to speak of the value of gold as changing, when measured by gold. We might as well say that the yard measure is longer when there is more cloth, or that a ton is heavier when there is more iron.

The unit of value, therefore, in England is this piece of gold weighing nearly a quarter of an ounce, and called a "pound." All monetary transactions in the British Islands are expressed in this unit, or in divisions of it. The divisions are arbitrary, but it is to be noted that they are represented by most convenient coins. The pound sterling expressed by a sovereign is a convenient coin. One twentieth part of that, the shilling, if it were made of gold, would be an excessively inconvenient coin, and utterly impossible of daily use; but a twentieth part of a sovereign expressed in silver is a very convenient form of money. The copper coin called the "penny" is simply as large a piece of copper as any person can conveniently carry in his pocket. The twelfth part of a shilling expressed in silver would be just as inconvenient as the twentieth part of a sovereign expressed in gold. Copper, therefore, comes in conveniently, and the penny is the unit of value in copper coins. But it must never be forgotten, as above shown, that silver and copper coins have no legal value beyond the amount that a man can conveniently carry in his pocket, that is, £2 sterling.

If then, it is proposed that silver coins shall be created as money, so that a definite weight of these coins without limitation shall be equivalent to so many pounds, the reply that must be given is that to maintain such a value in gold for the silver coins, would be impossible in the nature of things; just as impossible as to fix the value by law of a bushel of wheat, a ton of iron, or a yard of cloth.

But it may be rejoined, if all the governments of the world representing commercial nations, joined in an agreement that in their coinage and currencies a given weight of silver should always be equivalent to and exchangeable for a given weight of gold, would that not have the effect of causing it to be so? One single government, it may be contended, could not fix the price a which an ounce of silver shall be estimated in gold, or *vice versa*, and obviously for the reason that if the market was open to all the world, all the world would pour in supplies of silver if the price was high, and would withhold it from any country where the price was low. But if all the world joined in this agreement, then, the object surely could be accomplished. This is a plausible argument. But there is a fallacy lurking underneath this phraseology of "all the world." What is meant is the respective *governments* of all the world; not all the millions of individuals living under those governments.

Now the power of any government, it must be admitted, is limited. It cannot control all the actions of the millions of people that are subject to it, and especially in matters that affect the personal interests of individuals. It is certain that no government could compel all its citizens or subjects to buy and sell at prices fixed by that government. Government interferes with certain departments of trade in the way of excise, supervision and the exaction of customs duties. That interference is tolerated for the general good, and is in reality not burdensome. But for every government in the world to say to persons engaged in silver mining or silver trading, that their commodity shall count for so much and no more, in relation to the standard of value, would be an arbitrary interference that would never be tolerated.

The idea of this matter being determined at the beginning and constantly regulated hereafter by an International Clearing House or Committee, is a plausible endeavor to meet the difficulties that surround the question.* But the idea is chimerical. An International Clearing House, in the proper sense of the word Clearing House, is simply an absurdity. A Clearing House is a place where a definite number of persons, who have in the course of business, constant claims upon each other, can meet every day for the mutual adjustment and settlement of those claims. Such a clearing house can only, in the nature of things, apply to the merchants, brokers or bankers, of a single city, for even if it were attempted to have a clearing house for a single Province, or a single State, insurmountable difficulties would arise in its working. What then would be the difficulties of a clearing house for the whole of Canada, or the whole of the United States?—Still more if such a clearing house was proposed to embrace the whole world. It is obvious that there can be no more a single clearing house for the whole world than that there can be a single stock exchange for the whole world.

The idea, however, is not, strictly speaking, that of a clearing house at all, but of a committee of intelligent persons who shall settle this matter on a given basis to commence with, and determine that an ounce of gold is exchangeable for a certain number of ounces of silver, and then that this committee shall sit *en permanence*, and determine the same ratio from time to time, and deal with all the circumstances that might occur and disturb it. Now it would be perfectly easy to organize a committee for the purpose, provided men of sufficient ability had a sufficient inducement to set aside other engagements, and meet in some central place to consider the question. It would be easy for them to discuss, as has been discussed already, what this ratio should be. But experience has shown that the probability of their coming to an agreement would be extremely remote. Let us, however, suppose that an agreement was reached; and that it were promulgated throughout the world, that in the opinion of this International Committee, a proper ratio between gold and silver was so much, no more, and no less. That, however, would only be the initial step of a difficult business, for unless all the governments of the world, with no single exception, agreed to be bound by this decision, the meeting of this committee would be a mere academic meeting, and result in nothing but an academic opinion. But let us suppose that all the governments of the world, which is most improbable, agreed to be bound by the decision of this committee, and by all future arrangements and decisions of this committee, does any one suppose that in the multifarious operations of mining, commerce, banking, and exchange, going on day by day all over the world, that any government could pretend to *enforce* the decisions of such a committee, that they could by any possibility punish those who conducted their business without regard to its decisions, that they could fine or imprison the merchant or silver mine owner who differed in judgment in conducting his business. Such an idea is a transparent absurdity. On the first attempt to enforce by pains and penalties the decision of this committee, the whole mercantile world would be up in arms in every country, and demand from every government that the sittings of this committee and their arbitrary rulings should be put an end to.

We have looked carefully over the statements and proposals in this volume of Mr. Rothwell's and have come to the following conclusions about it:

First: There is in it an enormously exaggerated idea of the importance of the part played by gold and silver in the monetary transactions of the world. In all mercantile and civilized countries the actual handling of the metals is confined almost exclusively to the settlement of international balances—not international transactions by any means—but simply international *balances*. These balances are the merest fraction of the total transactions. In the vast volume of the monetary transactions of the United States, gold plays such an insignificant part, so far as actual handling is concerned, that it is

*This article has been suggested by a perusal of the work on "Universal Bimetallism," published by the Scientific Publishing Co., New York, written by Mr J. R. Rothwell, editor of the *Engineering and Mining Journal*, New York.

scarcely ever seen. Still more is this the case in Canada. The monetary transactions of the larger class of banks in Canada amount to between five hundred millions and a thousand millions in a year. In all this enormous mass of transactions not $100,000 of gold will be handled, and often much less. Gold plays a part in Canada of less than one in ten thousand. The clearing house transactions of New York have averaged about 32,000 millions of dollars for several years back, all which was settled without the intervention of gold. The transactions of the London clearing house last year, reduced to dollars, amount to 35,000 millions, and though the gold sovereign is part of the daily currency of England, owing to the fact that no notes less than £5 can be circulated, even this prodigious volume of transactions was settled without the intervention of gold. The gold metal is a *support* to currency and business transactions, and furnishes the basis on which they rest, and also the standard by which they are measured. There, practically, its function ceases, so far as the United States and Canada are concerned. It is therefore an utter delusion to imagine that there exists any necessity to increase the stock of gold in consequence of some supposed action looking to the future de-monetization of silver. For in practice silver has long been demonetized in the United States, and it is demonetized both in practice and theory in Great Britain and in Canada.

Second: Mr. Rothwell has committed a very grave blunder in estimating the bearing of the use of silver in the countries of the world according to population. The population of the countries who carry on business on a silver standard alone is stated to be 67 per cent of the whole population of the world. But how much business commerce, banking and currency have these hundreds of millions in China and India, as compared with the much smaller populations of European countries. Great Britain alone, with one-tenth of the population of China, has certainly at least ten times as much in volume of monetary transactions. And it is not to be forgotten that the whole of the banking carried on in these countries of vast population is by British banking institutions; and that all their foreign commerce has to be carried on on a gold basis.

Mr. Rothwell's treatise bristles with misstatements, misapprehensions, and delusive ideas respecting advances in the *value* of gold (we might as well talk of the advance in weight of a ton), reductions in the rate of wages, the possible demoralization in consequence of an increased demand for gold, and other matters, in all of which his ideas are contrary to the experience of the past, and to the actual developments of business and finance as we see them in the world to-day, and the idea of a double standard and of an international clearing house, so-called, to maintain it not the least of these delusions.

It may be pointed out that in the table given of the approximate stocks of money in the world, some most astonishing blunders have been allowed to creep in. In the column containing what is supposed to be the gross total of money in the world, there is an entire omission of 810 millions for Russia, together with an error of 56 millions in the column for Canada, and 60 millions in the column for Cuba and Hayti. These gross and enormous errors should not have been allowed in a final revision of a work in which so much is made of figures. But we may be allowed to say that not the slightest dependence can be placed on the greater part of these figures, even where they are correctly printed. They are evidently, in many cases, the merest guesses, and to those who have practical knowledge of the subject, some of them look like very wide guesses.

EN PASSANT.

For having the temerity to protest against the notorious tardiness that characterises the publication of that much abused volume of mineral statistics issued by the Geological Survey, Mr. W. Hamilton Merritt has provoked the ire of the officer in charge and drawn from his pen a flood of sour and ill-natured verbosity. This labored disquisition occupies a full column in the *Empire* and seems to have involved the vocabulary of the staff. From all we can gather it occupied in its composition nearly as much time as the precious Annual Report itself. In parts it sparkles with the peculiar genius of the director: in others the master hand of "Honest John" has evidently been requisitioned to give that acety of "twist and turn" (not the *in-turn*) for which the learned librarian is noted. To us it has had more than a passing interest inasmuch as, strange to relate, the greater portion is devoted to an exceedingly minute review of our *Canadian Mining Manual*—the number of its pages, the character of its contents, the known reputation of its contributors, yea verily even the price is not forgotten—facts, evidently quoted to give force to the remark that the *Manual* "in its own sphere of utility has many excellencies." Such gratuitous advertising does not come our way every day and we are profoundly grateful. The remainder of the letter is a fling at Mr. Merritt, somewhat offensive in its personalities. As a reply to his remarks it is a *complete failure.*

As if to justify and more fully emphasise Mr. Merritt's comments we have before us *fresh from the press* the Annual Report *for the year 1891*, the main feature of which, as in preceding issues, is its remarkable antiquity. Hoary and mildewed with age, it comes to us with its copious repetition of figures from Customs returns, and reprints from Provincial Mines Reports which, having been printed and distributed from their original sources nearly two years ago, are now practically obsolete and useless as an up to date reference. In 200 pages (including an index) we find little that is original or of value. Nearly *fifty* pages are culled holus-bolus from the report of the Minister of Mines for British Columbia for 1891; about *thirty* from Dr. Gilpin's report for Nova Scotia of the same period, while *ten* pages are given over to a reprint of Mr. Klein's paper on the asbestos industry read in July, 1891, before the General Mining Association of the Province of Quebec. Add to these the space occupied by the bulky reproduction of figures copied from the Custom's Reports and one can readily sympathise with the onerous responsibility entailed upon Mr. Ingall and his staff which requires such "careful compilation and therefore must take longer to complete and issue than those carrying less responsibility." Why we will undertake to furnish him with an office boy who, with little discrimination in the use of his scissors and paste, will reproduce three parts of his last Report inside of half an hour.

To the public and particularly foreign capitalists seeking investment in our mines and mineral lands, there is a real and urgent necessity for an official report which will provide them with information that can be commercially applied. A volume which, while reviewing yearly the status and progress of our mineral industries, will post the enquirer on known locations in which particular minerals are found and may be looked for in workable quantity, the history and operations of working mines, the methods of working and treatment, capital invested, labor and machinery employed, cost of working, statistics of output and exports, disposition and uses, market and freights of the year, and other particulars of a like nature constantly sought after by the new-comer with an eye to business. A report based on lines somewhat similar to these would be an immense boon to the country and would be of more real service and advantage to the mineral operator than a bushel of such antediluvian statistical trash as the volume at present before us. Doubtless there is truth in the contention of Dr. Selwyn that commercial data is beyond the jurisdiction of a Geological Survey. But surely one has a right to look for it from a Bureau or Division of Mines, supervised by a qualified mining engineer, and equipped with a staff sufficiently large enough to acquire and prepare it for early publication.

In thus commenting upon the Report, we desire it to be distinctly understood, that it is far from our desire and intention to cast any reflections, personally, upon the Chief and staff of the Division of Mines and Mineral Statistics. Mr. Ingall is well known to be a capable and efficient officer, and is held in high esteem by his fellow workers and the mining men of the country. During the past year too, sore family bereavement and a severe illness interfered greatly with the supervision and work of his Division. We

are well aware that his work is beset with many difficulties. The narrow and limited, and comparatively valueless lines upon which the Report is cast, were formulated before his day. But circumstances have changed. Each of the provinces has now its own Mining Bureau and its special mining officers, and armed with legislative powers which the Geological Survey does not possess, they are in a far better position to obtain and publish in their yearly reports, all the statistical information up to date, that is ordinarily required by the miner. If the Survey desires to keep abreast with the times and the requirements of the Canadian mining industry, it will proceed immediately to remodel this report. Perhaps we might suggest a careful study of that published by our cousins across the line, under direction of Dr. Day. Anyway, let us have a Report that will be of some use, and, above all, let its contents be fresh.

The many friends and acquaintances of Mr. Walter W. Pickford, for many years manager of the High Rock phosphate mine, and now superintendent of the Illinois Phosphate Co., Florida, were pleased to welcome him and his bride in their midst for a few days during a brief visit to Canada, on their way to Florida, from England. The REVIEW joins with Mr. Pickford's galaxy of friends in the phosphate business, in extending to him and his charming bride, its heartiest good wishes and congratulations.

Students of physics should welcome the appearance of an English rendering of Professor Mach's essay on "The Science of Mechanics." As a rule, mechanics has been treated as a branch of mathematics, and the Prague professor opened a new vein of inquiry when he began in an earlier work to regard it as one of the physical sciences. His views have since had development and confirmation from other independent sources, and the sense of his teaching on this matter was set forth for general students in the treatise which he contributed some ten years ago to Brockhaus' "Internationale Wissenschaftliche Bibliothek." It is from the second edition of that work that Mr. McCormack has made his excellent translation. The book, setting forth as it does the elements of its subject with a lucidity, clearness, and force unknown in the mathematical text books, is admirably fitted to serve students as an introduction on historical lines to the principles of mechanical science; and this business-like rendering of the treatise deserves the attention of both teachers and students of this important branch of knowledge. The work is published on this side by the Open Court Publishing Co., Chicago.

The REVIEW desires to acknowledge the courtesy of the *Engineering and Mining Journal*, New York, in kindly forwarding for its use in the present issue the engravings illustrating the exhibits of nickel from the Canadian Copper Co. at the World's Fair, Chicago.

In this number we present our readers with a mass of information, statistical and descriptive, respecting the mica mining industry of Canada. Of interest, too, should prove the data given respecting the properties, operations, output and shipments of the Lake Girard Mica Mining System—probably the largest and best equipped mica producer on the continent. Some idea of the extensive operations of this company may be gathered from the fact that since its organization up to the end of the year ended 31st July last, it has expended in the acquisition of lands and buildings, $97,500, and on machinery and plant equipment, $24,000. 200 persons found employment in and about the mines, and 20 men, 30 boys and 45 girls at the factory. 15 men were also employed in teaming mica and supplies. The distribution of its expenditure on account of wages during the same period was: at the mines, $56,276; in teaming, $6,830; or a total of $63,106, which, together with $20,090 at the factory and $1,875 in management, brings the amount up to $85,071 for a period of 26 months. The shipments of cut mica from September, 1891, to September, 1892, were 55,824, and from September, 1892, to July 1893, 66,140 lbs. Of trimmed mica from September, 1891, to September, 1892, 36,545 lbs.; from September, 1892, to July, 1893, 73,022 lbs. An idea of the capacity of the System's factory can be gathered from the fact that during the months of January and February, 1893, 16,315 lbs. of cut mica and 12,292 lbs. of trimmed mica were prepared for shipment. The average monthly output has been in the neighborhood of 5,000 lbs. of cut, and 6,000 lbs. of trimmed mica, while the stock of mica on hand at date includes some 1,200 tons of merchantable mica and about 250 tons of material for grinding.

By agreement under date of 30th September, Mr. W. R. Elmenhurst, Montreal has transferred and conveyed all his interest in the System to Capt. T. J. Watters, of Ottawa, who carries on the business under the same style and management as before. It is understood that the System will shortly be put before the public in the form of a joint stock enterprise with a view to enlarged capitalisation for more extended working. Until it is ascertained upon what basis the enterprise is to be floated the REVIEW refrains from further comment merely referring those of our readers who may be interested to the facts and data reproduced elsewhere in this issue.

As all our readers know, in consequence of the depression in the fertilizer market the production of Canadian phosphate this season has reached its lowest ebb, the majority of the mines having closed down. But the actual figures may prove of interest, so we quote the shipments from Montreal to Europe during the year as given by Customs Manifests:

By Wilson & Green	2,606 tons
By British Phosphate Co. (Ltd.) ...	1,590 "
By General Phosphate Corporation.	716 "
Total reported at 14th Oct	4,912 "

Several shipments have also been made to the United States, but no returns have been received at date of going to press.

The *Otago Daily Times* of May 8th says:—One of the largest blasts that has taken place in New Zealand with the explosive roburite came off on Friday evening, in the Blue Spur Company's mine, under the supervision of Mr. C. E. Stokes, representative in Australasia for the Roburite Explosives Company, London. The manager, Mr. J. Howard Jackson, had a tunnel driven into the face of the cement 36 feet, from which were two drives measuring each about 30 feet, in the ends of which were deposited 700 lbs. and 300 lbs. of roburite respectively. These charges were detonated with electric fuses connected with the dynamo. The face of the cliff was about 76 feet high, and the surface operated on extended about 150 feet. The manager estimates the cement dislodged by the explosion at 22,500 tons, but a great deal more than this would be the ultimate result gained. On examining the ground above the cliff enormous fissures were found extending back to a distance of nearly 80 feet, and it is expected that when the present dislodged mass is removed fully 25,000 tons more cement will be available without any further blasting. This strongly illustrated the power of this explosive, which is three times more powerful than blasting powder, and disintegrates the cement more efficiently. The cost is said to be about 25 per cent. less. In addition to this, greater safety is claimed for roburite, as it can only be exploded by a powerful detonator. The manager estimates that by this blast a supply for at least three months has been furnished from that portion of the claim.

One of the most important instances of the application of water power for electric power transmission in Great Britian at present is that at the Greenside silver-lead mines in Cumberland, which was designed by Mr. A. T. Snell about three years ago in conjunction with the mine manager, Mr. Borlase. These mines are among the few that find it possible to compete with foreign mines, and this is the case partly owing to a fine grade of ore which contains a large percentage of silver cheaply extracted by crystallisation, but largely because the use of electricity for winding, hauling and pumping has decreased the cost of working. On the east slopes of Hellvelyn lies a small natural lake called the Red Tarn, and on the north-east the impounded water of Keppel Cove. Between the two waters rises the hill of Catstycam, at the base of which the two overflows join, and near to which the Greenside Silver Lead Mining and Smelting Company have erected their turbine-dynamo station. The water is led from an elevation of 1,750 ft. above sea level, and flows through an open watercourse 1¼ miles in length to a large reservoir, from which it is conveyed down the hillside for a distance of 360 yards in 15 in. cast iron pipes. The fall at the station is equivalent to a vertical head of 400 ft., and the effective horse power is about 200. The generating station contains one of Gilkes & Co's vortex

turbines of 100 horse power, driving a four pole compound dynamo made by the General Electric Power and Traction Company. The house is large enough to duplicate this plant when necessary, and pipes, watercourses, &c., are already laid for this purpose. The electric current is conveyed by two bare copper conductors on poles for six furlongs, to where it enters the mine at an elevation of 1,850 ft. above the sea level. The conductors from this point are insulated, and covered with lead. About three-quarters of a mile in the mine, or one and a-half miles from the dynamo, a 9 horse power series motor is employed to wind ore from a set of sinkers. Further into the mine another quarter of a mile, and down 120 yards at the bottom level, is fixed another 9 horse power motor, working a three-throw pump, forcing the water 360 ft. in height. About midway between these motors there is fixed a dynamotor, which reduces the pressure from 600 to 250 volts for working an electro-locomotive in the lowest day level of the mine, through which runs the water pumped from the 120 yards level and the whole of the water used by two hydraulic winding engines, four horses formerly worked this level. The locomotive runs with twelve wagons, the total weight when loaded being 18 tons, and does the work of the four horses with the greatest ease. The conductors in the level are phosphor bronze wire, and the current is fed to the locomotive by four contact pulleys. The difficulties encountered in fixing this plant and wiring the level can only be appreciated by the practical man. All main stations in the mine are lighted by incandescent lamps in series of six.

Our Mineral Exhibits at the World's Fair.

The display made by Canada at the World's Columbian Exposition, has been one that, on the whole, did her credit in the eyes of the world. Nevertheless, it is to be regretted that the natural and economic products exhibited by the Canadian Geological Survey in the Mines and Mining Building were not shown in a more compact form and to greater advantage, as might very well have been the case. The Geological Survey, the Provinces of Ontario, Quebec, Nova Scotia, New Brunswick and British Columbia, together with the North-West Territories, were all represented within the Fair grounds. Manitoba had an interesting exhibit, but just outside the grounds. Of these—the Geological Survey collections may be described as being systematic and orderly—of a more technical and scientific character than any of the others, as can readily be expected. Yet, with these, there were also displayed an excellent exhibit of economic minerals, among which stood out prominently the very fine trophy of graphite and its manufactured products sent by Mr. W. H. Walker, of Ottawa.

The collection of rock specimens, exhibited by the Geological Survey, in charge of Dr. Selwyn, contained upwards of 1,400 exhibits of rocks from definite localities and formations in Canada —from Labrador and Nova Scotia, on the East, to Vancouver Island, on the West; and from the international boundary line on the South, to the most northerly districts of this continent. Every province and known or explored district was represented.

The Exhibit of the Canadian Copper Company, Sudbury, Ont., at the World's Fair, Chicago.

A notable collection of fossil remains, comprising some 2,400 specimens, illustrating the life history of the various formations in the earth's crust, as it is known in Canada from earliest Cambrian times was also shown. These fossil remains enable the prospector or geologist to tell whether he is above or below the coal line or in the neighbourhood of the petroleum or gas-bearing rocks, etc. It was the most complete collection of fossil remains observed in the Mining Building and was a credit to Canada.

Apart from valuable economic minerals we we have, in Canada, an almost inexhaustible supply of gems, precious stones and semi-precious stones that are an interesting study in themselves.

in the Court assigned to the Geological Survey was a collection of precious stones, most artistically arranged, exhibited by Messrs. C. P. Willimott & Co., Ottawa, that were admired by everyone, and the exhibition of which did much to reveal to strangers, and to many Canadians, too, the great mineral wealth in this line of many localities in the Dominion. Nature's great storehouse holds many secrets of our mineral wealth hidden away from mortal ken. This live firm have pierced the Stygian darkness here and have brought out before us Canadian gems and precious stones that but few ever dreamed were stored away in the bowels of the earth. We need no longer chase over the globe to gather up our ornamental gems and rich stones; we have them right here in Canada, right under our hands. Push and perseverance and scientific knowledge combined, have spread these things out in rich profusion before us. Let us see what they are like.

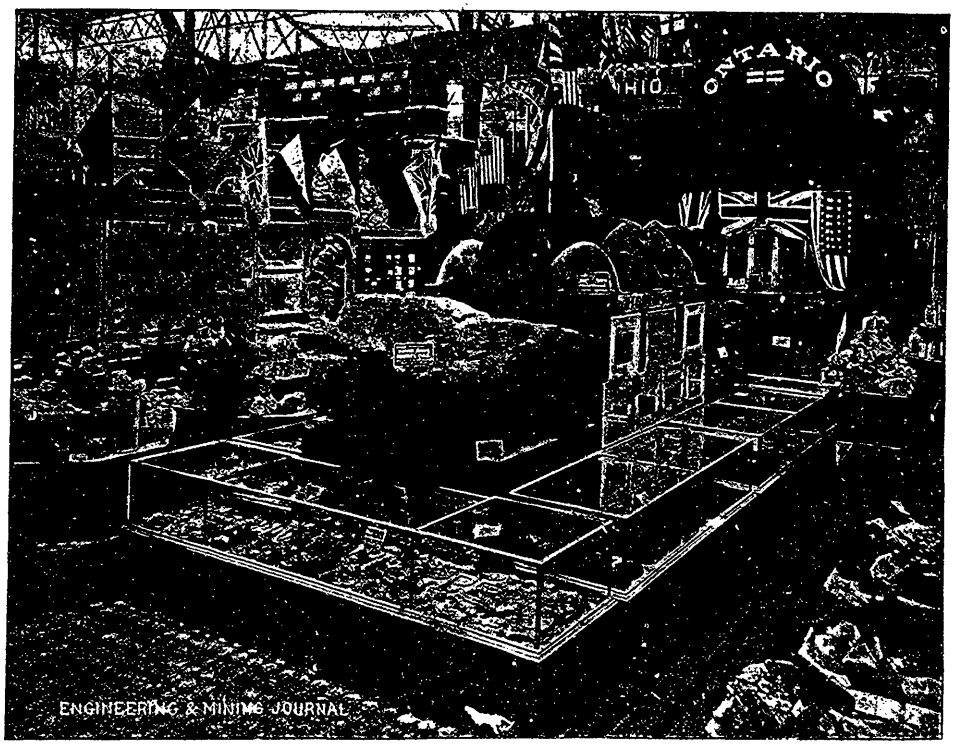
Among the rich specimens to be seen on exhibition were the lovely gems of quartz asteria, jacinths, grossularites and tourmalines. "Oh! what beautiful stones!" the lady visitor daily cried. Here were beautiful dress buttons made from the much prized Amazon stone of Ottawa county, in another case the most perfect dessert knives, with handles of the rich agates from the frowning cliffs of Blomidon, in Nova Scotia. In all shapes and forms of bright polished slabs, appeared such Canadian beauties as agates, jasper, porphyries, peristerites, perthites, aventurines, sodalites, wernerites, Labradorites, etc. Near by were a variety of articles manufactured from these beautiful and precious stones, such as knives, inkstands, stamp and match boxes, pencils, penholders, papercutters, button and glove hooks, tablets, an endless variety of charms, brooches and studs.

Resting among its handsome sister gems was to be seen in the collection, the bright, flashing quartz asteria, with its twinkling, changing, peculiar star—a Canadian gem that is now shining resplendent on more than one crowned head, and that in wealth and luxury sparkles in rivalry beside the not as handsome, even if more costly, diamond. The owners and wearers of this pretty stone say its brilliancy can be equalled by the diamond alone.

One striking feature of our Canadian gems is the variety and beauty of their tints. The grossularites and tourmalines from the County of Ottawa are resplendent in this respect. The former are found in this rich mineral district from colorless varieties to those of a golden yellow, while the tourmalines are of every shade of green and yellow, and have been mistaken for Oriental stones by expert mineralogists. These latter stones could be substituted, according to their shades, for a great number of other well known gems.

From the Renfrew district, Ontario, were the greatly admired jacinths beautiful gems that Canadian ladies have but to get acquainted with, when they will wear them quite universally.

Semi-precious stones are found in many places in the Dominion, and the collection in the Canadian Section of the Mines and Mining Building, have been admired, studied and most favorably criticised. Renfrew was here again to the front with aventurines that are, indeed, things of beauty and joy forever, with their artistically spangled surfaces, glistening with numerous specks of green, yellow and white. The Labradorites are always admired, while the vivid sheen of the peristerite, with its blue reflected light, makes it in every way superior to the Ceylon moonstone. The azure blue sodalite from



The Exhibit of the Canadian Copper Company, Sudbury, Ont., at the World's Fair, Chicago.

Ontario and the distant Rocky Mountains is another beauty, and surpasses the far-famed lapis lazuli, as it is slightly harder, takes a higher polish and is not marred by inclusions of iron pyrites.

The whole of this section was well worth seeing.

Ontario had a strikingly good exhibit. This go-ahead Province certainly did credit to herself. Mr. A. Blue, Director of Mines, Commissioner Awrey, and the able staff, of which Mr. Boyle was a conspicuous figure, have reason to be proud of the result of their months of arduous labor. The Ontario Court presented an attractive front, and the nickel trophy in the centre formed a unique and massive pyramid, impressive to the sight, and never to be forgotten by the passer

by. Iron ores, copper, mica, graphite, zinc, galena, asbestos, building stone, petroleum and its products, fire and brick clays, soapstone and apatite, or phosphate of lime, with its products, were shown in abundance and tastefully and artistically displayed. Due regard to the economic aspect of the exhibits was to be seen on all sides. The gold and silver ores also formed salient features in this Court, whilst salt, marbles, sandstones, granites, clays and cement stones served to complete the exhibits of a province whose mineral wealth is only now just being appreciated. Ontario's display of its mineral wealth was indeed an instructive one. To the economic collection was added a mineralogical one of considerable extent, furnished by a private collector in the person of Mr. W. G. Kidd, of Kingston, Ont. The nickel trophy deserves more than a passing mention. It was undoubtedly the most complete and extensive display of the kind ever made in the world. The exhibit of the only country which could compete with Canada was New Caledonia—a colony of France—and whilst its exhibit was certainly instructive and interesting, yet it was small and inconspicuous. Some of Ontario's specimens of nickel ore weighed 6,000, 8,000 and 12,000 lbs. respectively, and gave a capital idea of the extent and richness of our far-famed nickel deposits. Nickel anodes, nickel shot plates and ingots of nickel were also exhibited.

On a side wall hung a large and most instructive map of Ontario, which gave at a glance the location of the principal mining districts of the province. This province possesses a number of metalliferous belts which will eventually prove more remunerative even than at present anticipated, and with the increased population, an influx of capital, and careful and economic mining, there is no doubt a future bright and hopeful is in store for Ontario mining.

Next to Ontario came Quebec and British Columbia. Both had very attractive exhibits.

British Columbia had a thoroughly systematic and well arranged display, and one could get from the descriptive matter on the labels attached to the exhibits more information than from almost any of the exhibits observed in any of the Courts within the Mining Building. A conspicuous pyramid of gilt bricks, with the figures $53,512,652 being the amount of gold produced by British Columbia in about 30 years time from its placer fields, showed what that province can produce, and promises well when hopes are entertained of equalling some day the output of California, whose display in an adjoining Court shows the ores, placer deposits and other mineral products to be much the same, similar in character, nature and origin. Samples of the gold from Cariboo, Cherry Creek, Okanagan, Yale, Bear River, Antler Creek, California Creek, Mosquito Creek, and from the Ophir mine, Cassiar, and other localities too numerous to mention, were attractively displayed in a handsome and neatly arranged case. Every known mineral district was represented and carefully looked after by the Provincial Commissioner, due prominence being given to the new promising argentiferous galena regions now being opened up.

The Province of Quebec exhibit deserves especial notice, inasmuch as the display (though not comprising all the minerals which the province produces), nevertheless showed clearly and to advantage its industries and mineral products. The magnificent display of mica, second to none in the world, came in for a large share of attention. Quebec had indeed a beautiful exhibit of the different varieties of that useful mineral—muscovite, phlogopite and biotite micas. The Lake Girard and Haycock exhibits were the most conspicuous and formed attractive features.

General View of Canada's Mineral Exhibit at the World's Fair.

Asbestos—naturally—came in for a large share of attention. Canada is well known to "beat the world" in this product. The trophy and glass cases with the numerous and magnificent specimens displayed at once attracted the eyes of all the visitors, a good proportion of whom purchased asbestos souvenirs, which will do much to spread the fame of one of our most remunerative mineral industries.

Phosphate of lime, or apatite, formed an attractive series of pyramids. Canada's apatite deposits are so well known, and especially to Canadians, that a description of the various localities from which they were derived is deemed unnecessary here. One point is certain, that Canada's apatite deposits are rich and of a very high grade, being superior in quality to Carolina or Florida phosphates, and when the present depression in the fertilizer market vanishes, as surely it will in the near future, its production will again assume a leading place in the industries of the country.

The iron and copper ores of Quebec were well exhibited, together with their products. From the historic mines of the St. Maurice Forges to the more recent finds, there was an interesting display. Besides these, were samples of petroleum from Gaspé, a new oil field, which is now attracting special attention; mineral pigments, plumbago, galena and other minerals were so displayed as to form a first-rate commercial exhibit, reflecting the greatest credit upon Commissioner McIntosh and his staff.

Leaving out of consideration a comparatively insignificant gold exhibit from Nova Scotia, the display made by the Maritime Provinces at the Columbian Exposition was certainly not by any means creditable.

In the first place, there were hundreds of small specimens lying helter skelter in glass cases, which ought to have been arranged and properly labelled, or else thrown out as unworthy to represent the products of such an important mineral field.

Nova Scotia, with her coal, gold, iron, gypsum and building stones, might have made a magnificent display. Pyramids of attractive height, laden with such samples of its numerous mines as only this province can show, should have been erected, and the world could have seen at a glance what great wealth she actually possesses.

New Brunswick had one specimen worthy of note, a large block of sandstone, but this, unfortunately, was hidden in a corner out of sight. All told this Court was not what it should have been.

The coals of the North-West were very partially and sparingly represented. Specimens and blocks from the Bow River Pass, from Lethbridge, from Edmonton and Anthracite, were to be seen beside some building stones placed on a table in a corner near the Quebec Court.

On the whole, however, it must be admitted that Canada's exhibit at the World's Fair, whether judged by the excellent display made by the Geological Survey or by those of the various provinces, gave a very comprehensive idea to visitors of her great natural resources and the splendid field they offer for investment.

A.

THE CANADIAN MICA INDUSTRY.

The Occurrence, Production, Exports and Uses of the Mineral, together with a Description of Canadian Mines.

Since the application of mica for electrical purposes, the production of this mineral has assumed during the past two years considerable importance and has attracted, on account of its abundant occurrence in Canada, the attention of mining men and capitalists to the Dominion. The United States, and more especially the State of North Carolina, has largely contributed to the world's supply, but owing it is said, to the comparatively limited character of the workable deposits, the output from this source, as may be seen from a comparison of the last census returns, has materially diminished. Quoting from Dr. David T. Day's "Mineral Resources of the United States" for 1889 and 1890, being the last statistical volume issued by the United States Geological Survey, we find the returns of cut mica produced in that country from 1880 to 1890 given as follows:—

OUTPUT OF THE UNITED STATES.

Years.	Amount. Lbs.	Value. $.
1880	60.000	75,000
1880	81.069	127,825
1881	100.000	250,000
1882	100.000	250,000
1883	114.000	285,000
1884	147.000	368,525
1885	92.000	161,000
1886	40 000	70,000
1887	70.000	140,250
1888	48 000	70,000
1889	49.000	50,000

Writing of the occurrence of the mineral in the United States, Mr. L. J. Childs, (Eleventh Census of the U. S. 1890) says, "While deposits have been noted in nearly all of the States on the eastern border of the Appalachian mountain system, it is only in New Hampshire and North Carolina that the industry has assumed at any time much importance. In the West the most important deposits are located in the Black Hills, in the neighborhood of Harrisville, Wyoming, and in the Cribbensville district of New Mexico."

IMPORTS INTO THE UNITED STATES.

The importation of mica into the United States has steadily increased, the sources of supply being Germany, British East Indies, British Australasia, the United Kingdom and Canada, the official returns for a period of ten years ending 31st December, 1890, being as follows:—

1880 (30th June)	Value		$12,562
1881	"	"	5,830
1882	"	"	5,175
1883	"	"	9,884
1884	"	"	28,284
1885	"	"	28,685
1886 (31st December)	"		56,354
1887	"	"	49,085
1888	"	"	57,541
1889	"	"	97,351
1890	"	"	207,375

EARLY KNOWN OCCURRENCES OF MICA DEPOSITS IN CANADA.

Canada has long being known to be rich in the occurrence of economic mica deposits. More than thirty years ago, Sir William Logan, (Geology of Canada, 1863, pp. 494-5, and 795) referred to the deposits of muscovite, then known to exist on Yeo's Island, Cape Tourmente and other sections of the Province of Quebec. Mention is also made of the Phlogopites at Grenville, Que., and in North and South Burgess Ontario, "in all of which," says Sir William, "the mica is obtained in large sheets, which being transparent and free from flaws are wrought and employed for the same purposes as the muscovite or potash varieties." A crystal from Grenville was so large as to furnish sheets measuring twenty-four by fourteen inches. Good mica we are told was found on the tenth lot of the fifth range, and on the first lot of the tenth range of Grenville, as well as farther to the westward in the augmentation of this township. On the 17th lot of the Township of North Burgess, large crystals of magnesian mica were found in abundance in a bed of soft pyroxenic rock. The mica was traced for about 300 feet and considerable quantities were extracted. "It appears" concludes Sir William, "that in this region, and in Grenville, sufficient quantities of mica could be obtained to supply a larger demand." In 1884 an important deposit of muscovite was opened at the Villeneuve mine, in the Township of Villeneuve, Ottawa County, and a considerable quantity has been mined at different times up to the present date. Another early producer was the Sydenham Mica and Mining Co., in the Kingston district.

CANADIAN PRODUCTION OF MICA.

Until the past three years, the production of the mineral in Canada was limited, the out-put being almost wholly consumed by founders for the pannelling of stoves and furnace doors. A certain quantity, however, was ground for lubricants, fireproof paints and cements. Referring to the statistical report issued by the Division of Mines, (Geological Survey of Canada, 1891) we find the following returns —

1886	$29,008
1887	29,816
1888	30,207
1889	28,718
1890	68,074

The discovery of its value as an insulator and the rapid extension of its use in electrical practice, however, has had a marked effect in stimulating the development of the Canadian industry. In 1891 the production had increased in value to $71,510, while in 1892 and in the first six months of the present year the exports as reported to the CANADIAN MINING REVIEW were:—

Port of Ottawa, to the U. S.	$54,729.82
" Brockville, to the U. S.	6,608.44
" Kingston, to the U. S.	11,421.00

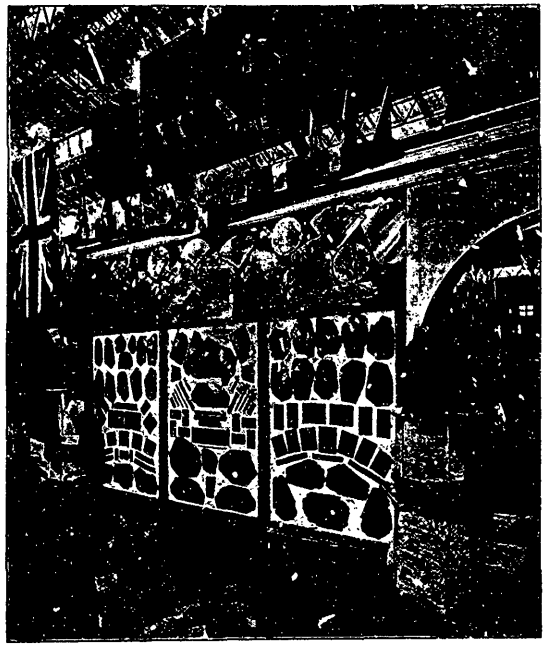


Exhibit of the Lake Girard Mica Mining System, given highest award at the World's Fair, Chicago.

" Montreal, to G't. Britain.	$ 615.00	
" " United States	1,473.00	
Total cut mica....		$2,088.00
Port of Montreal, to Great Britain	$ 179.00	
" " United States	4,313.00	
" " Germany....	485.00	
" " Newfoundland	25.00	
Total ground mica....		5,002.00
Total to 31st January, 1892 ..		[$79,849.26

To 31st July, 1893.

Port of Ottawa, to United States	$27,156 82
" Brockville, " (to end of April only)	3,614.53
" King-ton, to United States.....	19,155.05
" Montreal, to Great Britain and United States	1,792.09
Total from 1st Jan., 1893, to 31st July, 1893,	$131,567.31

COMMERCIAL APPLICATIONS OF MICA.

USE IN ELECTRICAL INSULATION—On account of its superior cleavage, Canadian mica is greatly favored by electricians in the United States, and notwithstanding a duty of 33⅓ *ad valorem*, it has more than held its own against local and foreign products in that market.

"The bulk of the mica used by us," writes the Edison General Electric Co. of New York, "is Canadian mica, which is known in the market as 'amber mica,' being of amber colour and clear. It is essentialthat the mica should be smooth, free from wrinkles and crevices, it must split readily and must be flexible, so much so that a piece of mica .010 in. thick would bend to a curvature of about 3 in. diameter without cracking. Mica that has dark spots or spots similar to rainbow colour, or what is known as smoky mica, is not at all suitable for electrical purposes. Mica must also stand a flame of intense heat without crumbling up or showing any disintegration. We give you below the principal size of mica used by us, and would say that at the present time we have orders out for some of the sizes ranging from 200 to 600 pounds:—Commutator mica: 1½ x 4 in., 1¼ x 6½, 1⅝ x 4¼, 1⅜ x 6½, 1⅜ x 8, 1¾ x 8, 2 x 5, 2½ x 5, 2 x 7, 2 x 12, 2½ x 12, 4 x 4, 5 x 8. Binding mica, 1¼ in. wide."

"The insulating power of mica," says an eminent electrician, is superior to that of any other substance applicable to armatures. An advantage peculiar to itself, is its even laminated structure. The builder of armatures can split the sheets into any desired and uniform thickness with great ease and accuracy. A valuable property of mica in connection with commutator insulation is its proper degree of hardness, it does not wear away too rapidly under the action of the brushes.

Of all substances mica is probably the best material for use in armatures, if it is desired to obtain not only efficient electric insulation, but also durability under the influence of heat. The highest temperature to which an armature is subjected even by short circuits or bad constructions, will have no injurious affect on mica. Mica thick or thin may be held in a gas flame without burning or melting.

Mica for electrical purposes must be flexible and non-conductive. Color does not matter, but perfect cleavage is of the highest importance, as "electrical mica" must be of uniform thickness, and is often gauged to the thousandth part of an inch. Thesizes and shapes of sheets vary greatly, 450 different patterns having been called for. The price is from 10c. to $2.50 and upwards per lb., and varies with the size of sheet and difficulty of cutting the pattern.

MICANITE—One of the most recent uses to which mica is commercially applied is in the manufacture of micanite, by which large quantities of scrap or inferior qualities are utilized, and by means of a patented process, small pieces of waste mica are built up into sheets 40 inches square and larger if necessary. The product can also be made in any desired form and is largely supplied to the electrical trade for insulating purposes.

PAINTS, WALL PAPER AND ORNAMENTAL USES—Another use for mica is its application, when previously colored or metalized, to ornamental purposes. From its unalterable nature the material preserves gilding, silvering or coloring from deterioration; and from its diaphanity, the articles so treated will preserve all their brilliancy. Finely ground mica, or colored gelatin, also shows handsome effects, and when mixed with a solution of gumarabic, it makes a good silver ink. The gelatin combination is used for inlaying buttons. Another beautiful application of mica is in the production of bronze-like colors, which bear the names brocades, crystal colors and mica bronzes. Among the advantages of these are that they are indifferent to sulphurous exhalations, are very light in weight, and in some colors are even more brilliant than the metal bronzes. When small particles of mica silver are spread over articles coated with asphalt varnish, the result is a good imitation of granite. The crystal colors are also suitable for calico printing; and fabrics to which they are applied surpass in brilliancy the heavy bronze and glass dust fancy fabrics of Lyons. Such colors have been used to decorate procelain and glassware, the articles undergoing a second heating up to the fusing point of their glazing. By suitable dyes, the material is colored to a variety of hues.

MICA FOR GLASSES AND SPECTACLES—The best employment of the immense quantities of scraps and fragments of waste mica which suggests itself as worthy of a wider field than it now possesses is the substitution of mica for glass in spectacles worn by workmen, especially stone and metal workers, to protect their eyes from chips and splinters. As already made in Germany, these mica glasses are concaved in the shape of watch glasses, and are about one twenty-fifth of an inch in thickness. The advantages gained by this utilization are greater than would at first be imagined. Mica spectacles cannot be broken. Pounding with a sledge hammer merely flattens them, nor does molten metal poured on the mica affect it. The shower of pointed iron particles which issues from lathes merely rebounds from the elastic mica glasses.

AS A LUBRICANT—The mineral is somewhat extensively used in the manufacture of mica grease. As a lubricant for railroad purposes its value lies in the fact that it is absolutely anti-friction, and it is claimed with its use hot boxes or journals are simply impossible.

OTHER USES—Mica has been used on board war ves-

View of a portion of Surface Works at Lake Girard Mica Mines, Township of Wakefield, Que.

sels, in localities where glass would be broken by the concussion due to the firing of heavy guns. It is made into reflectors, sea compasses, inlaying for wood instead of enamel. It is also employed for roofing purposes, and in several patented processes forms a water and fireproof covering for strata of rubber, tar, canvas, felt, and similar materials. Its most recent application in a powdered state, is to the so-called wax-printed cloths as shown at the World's Fair Chicago. These cloths are made by applying melted wax to the cloth with a stick in free hand designs, and *before the wax is dry powdered mica is* sifted over it. The effect is said to be remarkably rich.

GROUND MICA.—In recent years the preparation of ground mica has become an industry of itself, and several United States firms have gone into the business. Waste or scrap mica is generally used. The difficulties of grinding are great, owing to the tough and scaley nature of the material. Mills which work well on almost everything also fail utterly on mica. Recently there has been a return to old-fashioned burr stones, though most of the manufacturers keep their process a secret. The grinding is usually wet. Some manufacturers grind mica to a very fine powder for "specialties," but the sizes of ground mica usually made are 24, 40, 60, 70, 80, 100, 140, 160, and 200 meshes to the inch, and the prices range from 5c. to 10c. per pound. Scrap mica for grinding is bought for about $12 per ton at the mine. It must be free from rust or specks, which would affect the color and lustre of the product.

PREPARATION FOR MARKET.—Care is taken in mining to avoid drilling through the mica crystals, or to break them unduly. The mica thrown down by blasting undergoes a preliminary hand-dressing underground. It is then taken to the "mica shop, where it is split with knives into sheets of the required thickness, and afterward sheared into sizes. The workman has on his bench a stationary pair of shears and a large number of blocks or templates of the sizes to be cut. An experienced mica-cutter can tell at a glance the largest size which can be cut from a given piece of split mica; he selects the proper template, holds it on the mica, and shears the four sides, using each edge of the block as a straight edge. Each size sheared is set away by itself. The sheets are sheared by further scaling, if necessary, and finally packed in paper in pound packages. At the factory of the Lake Gerard Mica Mining System in Ottawa this hand labor is greatly reduced and a great saving effected by the use of patented cutting machines operated by electricity. These are described more fully in our description of the factory. The production of merchantable sheets is usually from 4 to 5 per cent. of the block mica brought from the mine, and may run as high as 8 or 10 per cent.

CANADIAN WHITE MICA LOCATIONS.

With regard to the occurrence of mica in nature, we have to distinguish in general two varieties, of commercial value, those which are essentially silicates of alumina and alkalies, chiefly potash, often with lithia and fluorine, including muscovite and lepidolite; and the magnesian micas, phlogopite and biotite; the former generally belonging to granitic rocks, and the latter to limestones.

Among the principal localities where muscovite mica has been found to occur, are:—

(1) The Villeneuve mine, lots 30 and 31, Township of Villeneuve, Ottawa County, Que., where it is found frequently associated with tourmaline, and occurs abundantly in crystals in a coarse pegmatite vein.

(2) Allumette Lake, at Montgomery, Renfrew County, Ontario, where large plates and crystals occur, in a vein of graphitic granite.

(3) Yeo's Island, on the Upper St. Maurice River, Portneuf County, Quebec, in association with black tourmaline and inclusions of white sub-transparent quartz.

(4) Lac Pied des Monts, about six miles from Murray Bay, Quebec.

(5) Escoumaine mine, 25 miles from Tadousac, Que.

(6) Lot 8, range VII, Township of Masham, Ottawa County, Que.

(7) Lot 4, range XI, of Township of Muller, Frontenac County, Ontario.

THE VILLENEUVE MINE.

Prominent among these locations is the Villeneuve mine, the pioneer producer of the country. The first operations date back to 1884, when it was first opened by Mr. W. A. A lan, Ottawa, by whom it was transferred to the British and Canadian Mica and Mining Company, who in turn, after working it successfully for some time, passed it into the hands of Mr. S. P. Franchot, of Buckingham, the present owner.

With slight interruption the mine has been operated up to date. From 1884 to 1888, about 35,000 lbs. of cut mica was reported as having been taken out, the product being of fine quality, clear and free from spots, realized *good prices. Since then it has been worked for mica and* feldspar, shipments of the latter product being made to England and the States, where it is utilized in the manufacture of porcelain and potteryware. Of the output of mica from the mine since 1888, no figures are at hand.

The Villeneuve muscovite occurs chiefly in crystals between the contact of pegmatite and gneissic rock and yields for the most part flat sheets without wrinkles or crevices; the vein is said to have a width of 400 in N.E. direction. Black and red tourmaline is frequently met with and the laminae show frequently red or black spots of this material.

Large quantities of this mica have been shipped to England and Austria. The mine is equipped with a steam and air compressor plant and a suitable working force is employed.

THE HAYES MINE, MURRAY BAY.

Recent development work in the Lac Pied des Monts mine, Murray Bay, owned by Mr. F. B. Hayes, Ottawa, has given very satisfactory results; large crystals up to 2 ft. in diameter have been obtained. The mica is of remarkably fine quality. The single laminae show frequently the occurrence of tourmaline of black, red and green color, a great quantity, however, yields clear sheets. Three tons of large sized black mica has been taken out inside two and a half months. Large quantities of this mica are to be shipped this month to Germany.

THE OCCURRENCE OF AMBER MICA.

Concerning the second variety, the phlogopite or amber mica, its occurrence is very common among the Laurentian limestones, sometimes in more or less abundantly disseminated small scales or crystals of pure limestone and dolomite. The colors of these crystals are generally some shade of yellow or brown; but in rare cases they are of a deep olive green or silver white. "At the Calumet Falls," (Geology of Canada, 1863), "delicate olive green prisms of phlogopite, sometimes an inch in diameter and several inches in length, are found imbedded with crystals of pyroxene in a pink lamellar limestone. In Burgess, Ontario, large tables of a steel-grey mica, with a somewhat metallic lustre, are found in a similar limestone with crystallized apatite, a prism of which was in one case found imbedded in a crystal of mica." The largest specimens of phlogopite are generally found in beds near to *bands of quartzite or pyroxene gneiss, which often limit* the crystalline limestones, or are interstratified with them. The mica occurs in large tabular crystals with pyroxene and calcite and often with quartz, orthoclase and rarer minerals. The principal areas where these phlogopite deposits have been found in Canada are in the Provinces of Quebec and Ontario, and more especially in the counties of Ottawa, Perth and North Burgess.

The often expressed opinion that the mica deposits were of superficial character or were downward to a limited depth, has been fully disproved by the great development work carried on by the largest Canadian mica company, "The Lake Girard Mica System." It has been proved by the operations of this company that the de-

View of Lake Girard Mica Mine, looking from Lake.

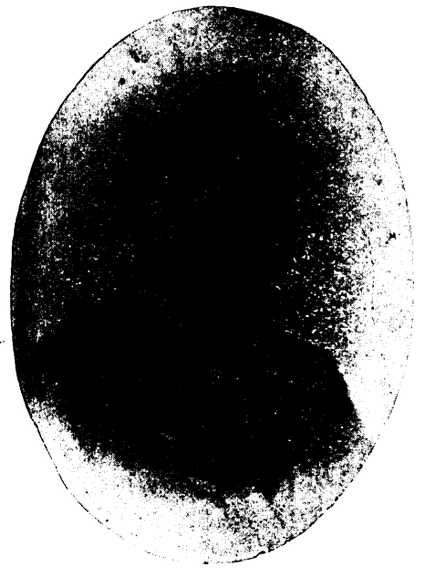
posits though frequently interrupted by dead ground, continue to the depth and are for the greater part in connection with each other by chains of small sized mica crystals, by fissures filled with mica matter or by bands of soft reddish limestone. In following this theory valuable discoveries have been made in considerable depth.

CANADIAN AMBER MICA LOCATIONS.

Some idea of the extensive occurrence of amber mica in Canada may be gathered from a reference to the following localities where it has been found :—

Lot 1, Range II., of the Augmentation of Grenville, Argenteuil County, Que.
Lot 9, Range VI., of Grenville, Argenteuil County, Que.
Lot 17, Range VII., " " "
" 1, " V., " " "
" 19, " VIII., of Portland, Ottawa County, Que.
" 10, " X., of Templeton, "
" 9, " XI., " "
" 10, " V., of Hull, "
" 9, " XII., " "
" 13, " XV., " "
" 1, " IV., Masham, "
Aylwin, Ottawa County, Que.
Lot 22, Range II., Cawood.
South Burgess, Leeds County, Ont.
Lot 6, Range VIII., North Burgess, Ont.

Needless to say, not all are workable deposits, nor do all of them warrant the necessary expenditure for mining. In many cases we find small and limited deposits containing contorted and twisted mica, yielding only a very small percentage of cut sheets. Very promising properties, however, have been discovered in great number in the district of Wakefield, Templeton, and on the Lievres River. Among the many localities which have been worked with success are :—



Mr. C. C. Symons, Mine Captain, Lake Girard Mine.

(1) Lot 15, in the 11th Range of Templeton, owned by the Templeton and North Ottawa Mining Co. There were on the surface two veinlike deposits with small contorted crystals at a distance of about 10 ft., the walls being parallel in width from two to four feet ; these were tested by a shaft, and in a depth of 15 ft. the two bodies came together forming a single vein of eight feet wide and crossing the whole size of the shaft.

This vein continued most regularly and in about 25 ft. depth a large phosphate body was struck, the vein split up and the crystals were distributed over the whole body. They were large sized and most regular in their structure, yielding a large amount of flat sheets. The output with a small force of men for two and a-half months working (including all preliminary work), is reported to be sixty barrels or nearly 20,000 lbs. of selected mica ; about 90 tons of phosphate of lime of 84% were also taken out.

It will be easily seen from these returns that this mine has been worked with very satisfactory results.

(2) Lot 15, Range 8, in the Township of Templeton owned formerly by Mr. A. W. Stevenson, C.A., Montreal, in about two months work yielded considerable quantities of large sized crystals and a good output of phosphate of lime. Exact figures regarding output are not to hand. The principal opening is situated on a mountain ridge, and consists of an open cut of 20 ft. wide, 25 ft. long, and 30 ft. deep, and shows on the walls and in the bottom large sized crystals with well defined sheets. One crystal taken out weighed 300 lbs. and cut 12 x 8 inches square.

This mine has been examined by experts and is considered to be one of the richest mica and phosphate mines in that district ; it is to be regretted that operations had to be suspended last year owing to ligitation as to title. It may here be stated that since the commencement of pending litigation, the rights of Mr. Stevenson have been purchased and are now possessed by Capt. Thomas J. Watters, the owner of the Lake Girard Mica System.

(3) Lot 17, in Range 8, Templeton, operated by Mr. J. Wallingford, has been worked for four months. The principal opening consists of an excavation 15 ft. wide, 25 ft. long, and 28 ft. deep. A vein of 8 ft. wide containing well defined mica crystals an crosses the shaft in east and west direction, showing large sized pockets and aggregates of mica in pyroxenic rock, frequently intermixed with apatite. 41 tons of selected mica have been taken out with an average number of eight men, and shipped to Boston to a large electrical concern. Five men have been steadily employed in cutting sheets.*

(4) Lot 15, in the 8th Range, west part Templeton, owned by Judge Dugas, Montreal. There are three openings on the mountain ridge which runs across the property. The largest excavation shows a vein-like occurrence of mica ; crystals of about 40 in. long, and 3 ft. wide have been taken out. This vein has been followed by a shaft to a depth of 12 ft., and has yielded a large quantity of well defined mica crystals. The three openings have been worked for nearly two months, and operations have been suspended on account of the lack of machinery. The output during that time was 80 barrels of 350 lbs. each or 28,000 lbs. of black mica. 5,500 lbs. run of mine were also cut and yielded :—

50 lbs.,	4 x 6 in.	and larger	$ 75.00
125 "	3 x 5 "	"	187.50
1,500 "	2 x 3 "	"	150.00
			$412.50

Capt. T. J. Watters, Ottawa, Owner Lake Girard Mica Mining System.

The largest and most notable producer of Canadian mica, however, is :—

THE LAKE GIRARD MICA MINING SYSTEM

organized in the latter end of 1891, and which at date owns and operates an area of 3,210 acres of mica land in the provinces of Ontario and Quebec. The disposition of this large property is as follows :

PROVINCE OF ONTARIO.

Name of Mine.	*Township.*	*Acreage.*
Martha	North Burgess	100
Pike Lake	"	200

PROVINCE OF QUEBEC.

Alice	Hull	100
Bradley	"	200
Cassidy	"	300
Charette	Templeton	200
Foley	Hull	200
Lake Girard	Wakefield	210
Murphy, P.	Templeton	100
Murphy, B. J.	"	200
Nellie & Blanche	Hull, Villeneuve, Templeton, Wells	1000
Prudhomme	Hull	80
Stevenson	Templeton	200
Snapshot	Hull	20
White mica	Portland west	100

* The prices obtained last month for trimmed mica sheets 1-16 in. thick were :—

For a ton,	5 x 8 inches	$400
"	4 x 6 "	275
"	3 x 5 "	150
"	2 x 3 "	60

The promoter and leading spirit of the Lake Girard Mica Mining System is Captain Thos. J. Watters, Assistant Commissioner of Customs, Ottawa, to whose energy and capacity more than to any other is due not only the position of the System as one of the largest producers of mica in the world, but also the development of the mica trade into an important Canadian industry. This gentleman is reported to have spent during the past two years, not less than a quarter of a million dollars in acquiring lands, erecting buildings and machinery and in the outlay necessary to place the system on a working basis. Mr. Don C. Watters conducts the business at the offices of the System on Besserer street, Ottawa, where also the cutting and dressing establishment of the system is located. A brief description of the occurrence of the mineral on some of the more prominent properties operated by the System and the methods of mining and treating the product may not be out of place. Our information is gathered mainly from the official reports of Mr. F. Cirkel, M.E., who has just completed an examination of the mines, from data furnished us by the System, and from a personal inspection by a representative of the REVIEW. Our engravings are reduced from Mr. Cirkel's drawings and photographs kindly furnished us by the System.

It is perfectly safe to say that the mine which has proved to be the most profitable source of its supply has been

THE LAKE GIRARD MICA MINE

situated on the 2nd range of the Township of Wakefield, county of Ottawa, Que. This mine is connected by good roads with Wakefield station on the line of the new Gatineau Valley Railway and is distant from the works at Ottawa about 22 miles. Mining has been carried on in the southern portion of the property on the border of Lake Girard. The country is hilly and covered for the greater portion with good hardwood suitable for building, burning and mining purposes.

Mr. Don. C. Watters, Ottawa, Manager Lake Girard Mica Mining System.

System of Working—The principal work at the mine has been done on shaft No. 1. Mr. Cirkel in his report says :—

"Shaft No. 1, which has been sunk at an incline of from 73 to 75 degrees in a chain of large sized mica deposits, measures near the surface 15 to 20 feet square, and widens gradually out at a depth of about 120 feet until it reaches the dimensions of 25 to 30 feet square in the 165 feet level. At a depth of 90 feet, or 6 feet above lake level, a drift marked E (map 2) of a size of from 8 to 15 feet square has been made in the western continuation of the mica deposits found in the shaft. At this level a test hole in the south wall of the shaft has shown four feet rock and eight feet mica, and to reach this apparently large deposit a cross-cut in southern direction, (marked A), has been put in operation. At the time of my visit this cross-cut was 28 feet long and its head-wall showed small pockets of reddish limestone with small mica crystals.

"Above the 165 feet level, where the shaft is widening out considerably, extensive deposits have been worked out, the continuation of which could be followed by drifting to the west in 133 feet length.

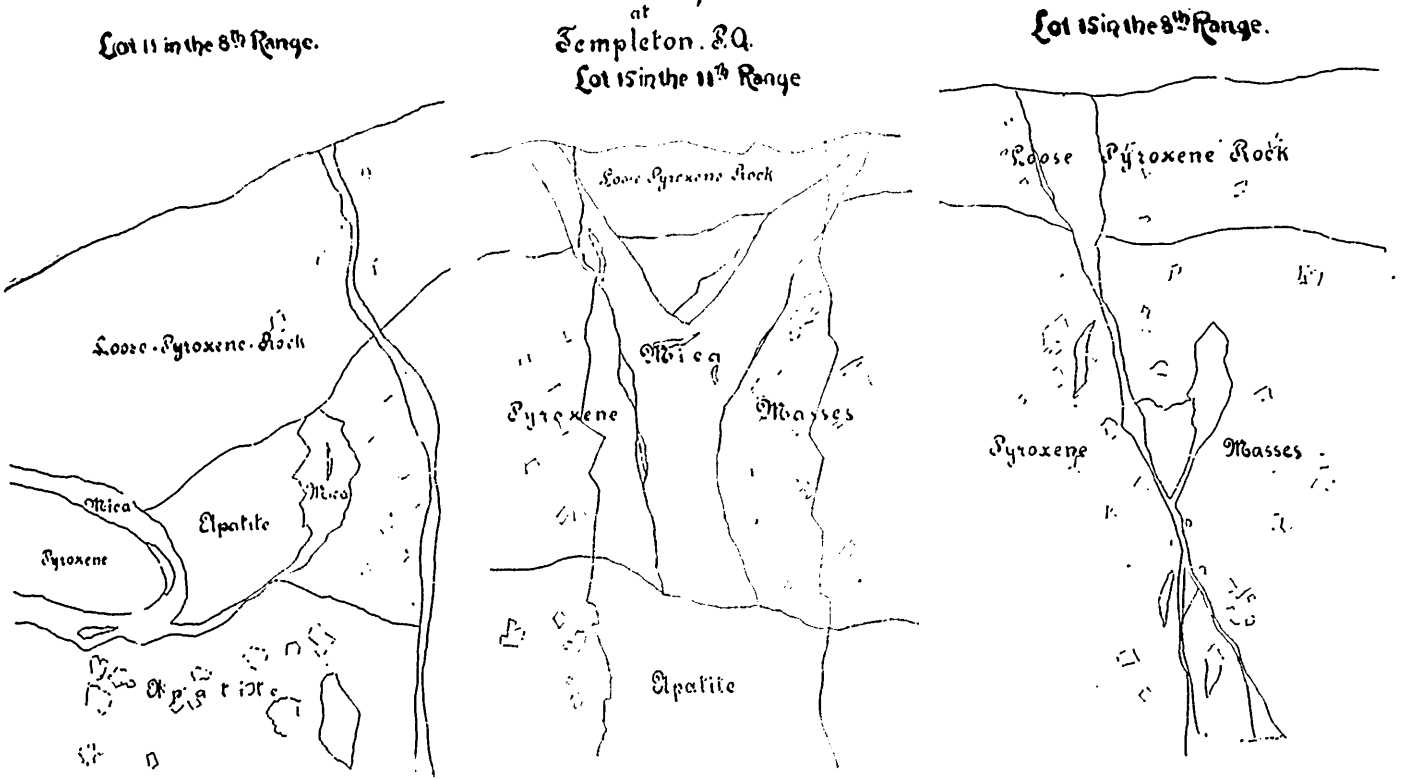
"By a southern cross-cut B, at a distance of 14 feet from the shaft and in a height of 10 feet, a deposit of crystals measuring 9 feet in width in the bottom has been laid bare ; these contain throughout crystals of a well defined character imbedded in reddish limestone measuring from ½ a foot up to 1¼ feet in diameter. It is the intention to work this deposit, which will continue according to its outline to the depth, from the 165 feet level by the southern cross-cut marked C.

"Drift G, to the east on the same level, shows in the bottom in 12½ feet distance from the shaft an aggregate of mica crystals, measuring in the end of the drift 8 feet in width ; the large sized crystals occasionally show

CANADIAN MICA INDUSTRY.

Reproduced from the Drawings of Mr. F. Cirkel, M. E.

Mica-Deposits at Templeton, P.Q.



Property of the Templeton Asbestos Mining Co. Ltd.

Property of The Templeton & North Ottawa Mining Co. Ltd.

Property owned by Mr. A. W. Stevenson, C A., Montreal.

cracks in the laminaes, but not of sufficient importance to prevent them from yielding a large quantity of commercial mica sheets.

"The horizontal southern continuation of the mica deposits in the 165 feet level led to the necessity of sinking a second slope at a distance of 25 feet from the first shaft; this slope is at present 45 feet deep, and has an incline of 75 degrees. Two drifts (marked D and A) in different levels, to the south and to the east have led to the discovery of valuable mica deposits. Drift H, to the east showed at the time of my visit, in the bottom, head-wall and roof, crystals measuring in size from half a foot up to 1¾ feet in diameter, imbedded in a soft reddish limestone frequently intermixed with large crystals of pyroxene. Drusy cavities have been met with very frequently and the crystals obtained therefrom are characterized by their sharpness of outline; these crystals were for the most part complete in their structure, yield laminae of 3 inches up to 8 inches square, being mostly free from wrinkles and crevices. The deposits measured in the bottom of the drift S feet in width and 12 feet long; large sized crystals were also irregularly distributed over the limestone in the head-wall and especially on the roof, so that this deposit may likely prove to be a continuation of the deposit in drift G of the 165 feet level."

In a supplementary report, under date of 13th August last, written after a later examination, Mr. Cirkel writes:—

"In a height of 25 feet from the bottom of the pit, a drift marked D, 8 feet high and 10 feet wide has laid bare extensive pockets of reddish limestone, one of which contained an aggregation of crystals in size from 6 to 8 inches in diameter; this deposit measured at the time of my visit 8 feet in width.

"Taking all the observations with regard to this vein together, I have to state that according to my experience, this deposit is the most extensive which has ever been discovered in the Laurentian system, and with such great results on hand, I only can repeat that the Lake Girard shaft at the present day is, and will be, the richest and largest producing mica mine so far known on the American continent."

Operations in Shaft and Equipment—The points of operation are at present cross-cut A in the 90 feet level, cross-cut C in the 165 feet level, drift H and cross-cut D in the 45 foot slope. Three 3-inch Ingersoll rock drills supplied with compressed air, are at work during day and night. The rock is hoisted from the bottom of the 45 foot shaft to the 165 foot level by buckets which empty by means of a dumping car into another bucket which goes through the upper shaft to the pit's mouth. This double handling of the bulk of material requires a lot of labor and is expensive but this will soon be overcome as a cut from the bottom of the 45 foot shaft through the north wall to the 165 feet level is being made so as to hoist in one way to the pit's mouth. Here the rock will be removed by a large car to the dumping ground on the east side of the shaft.

On account of the generally safe walls the shaft is timbered only near the surface, but is fitted with six safety platforms at an average distance of 25 feet from each other, and connected by inclined ladders. Drainage is provided for by two 3-inch pumps, worked by compressed air, in 118 and 165 feet levels respectively; the pumps are in use only temporarily as the quantity of water in the bottom of the shaft is very small. The shaft is equipped throughout on all platforms and working points by electric light supplied by a 100 lamp dynamo.

Buildings—This mine is equipped with excellent accommodation for a large working force, while the various buildings necessary for the operations consisting of engine and shaft houses, blacksmith's and carpenter's shops, cobbing sheds, stables, office and dwelling houses are strongly built and admirably suited for their requirements. It is noteworthy that each and all are supplied with the electric light.

Working Plant—This comprises two boilers of 38 and 54 h.p. respectively, and two 55 h.p. respectively; one seven drill and one three drill Ingersoll compressor and equipment; one double cylinder hoisting engine (Copeland & Bacon), and one double hoist 18" x 30"; Worthington and other pumps (three in number); Kay dynamo for 100 Edison lamps; derricks, etc.

Handling and Transportation—The mica as it comes from the pit is weighed and delivered to the dressing shed on the west side of the shaft where it is separated in different sizes; it is then carried by a car automatically handled on an incline track to the foot of the hill where the loads are taken up by waggons and transported to the cutting and dressing works at Ottawa. *En route* a stop is made at the very commodious stables owned by the system at the village of Cantley (see photo). Here the waggons usually meet those coming from Ottawa with supplies for the mines and the loads are transposed the horses from the mines returning to Lake Girard with the lighter loads and the mica going on with the Ottawa teams to the city.

Output from Lake Girard—The following table shows the output during six months in 1892 and during three months in 1893, according to statements kindly furnished by the manager of the System:—

(N.B.—The months of November and December, 1892, and January, 1893, are not included on account of a boiler explosion; during months of the May and June, 1893, an interruption of the regular operations was caused by some repairs to the air compressor plant.)

Month.	Output in Tons of 2000 lbs.	Number of Shifts.	Average Daily Output	Average No. of Shifts daily.
1892.				
May....	81·935	1206·5	3·1317	48
June....	91·1322	738	3·1285	29
July....	85·1160	798	3·846	31·8
August...	116·1976	791	4·1311	31
Sept....	106·479	946	4·499	37·8
October..	66·1029	890	2·1321	35·6
1893.				
February.	117·1114	1150	4·1404	40
March...	122 886	1836	4·1755	53
April....	82·186	1177	3·567	47

Average output daily in six months, 3·$\frac{1333}{2000}$ tons. Average number of shifts daily in 6 months, 35·5. Average output daily in 3 months, 4·$\frac{333}{2000}$ tons. Average number of shifts daily in 3 months, 48·6.

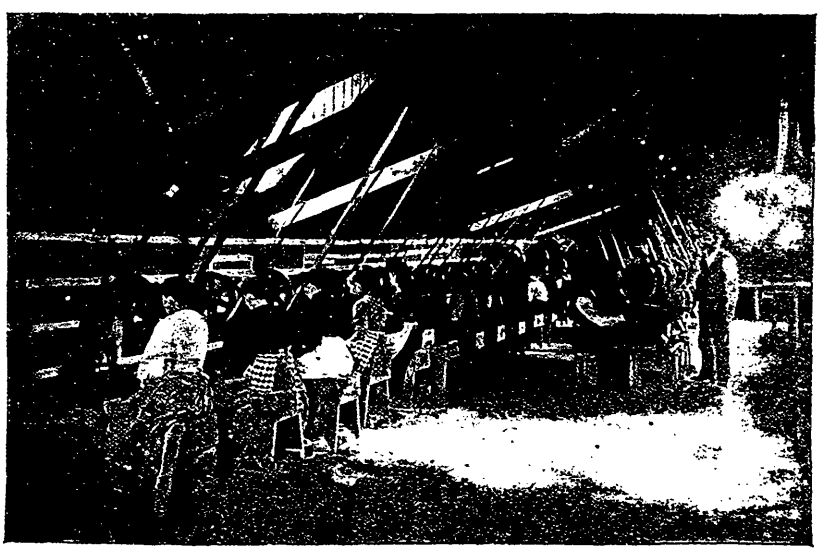
For the above 9 months the average daily output was, therefore, 3$\frac{1333}{2000}$ tons.

The Richness of the Lake Girard Deposit—In concluding his report on this property, Mr. Cirkel, after reviewing the work done on the various openings, remarks:

"Taking all observations with regard to the occurrence of mica deposits together in comparison with all the other mica mines working in the Laurentain I must state that the pyroxenic belt of the Lake Girard mine is the richest mica bearing belt at the present day so far discovered in the Laurentain system.

As already stated the average daily output amounted to close upon four tons with an average number of shifts 39·8; it is evident that in consideration of the number of workable deposits as described above this output can be largely increased when the difficulties caused by double handling of the material in the 165 ft. level and by the limited capacity of the present machinery plant has been overcome; without increasing the number of men the shaft should give, after an installation of the new plant, not less than five tons merchantable mica daily.

As a result of my examination I have no hesitation in saying the Lake Girard mica mine, according to the present prospects and with regard to the proved richness of the pyroxene belt on mica deposits, is at present and will be the largest producing mica mine so far known in the mica industry of the American continent."



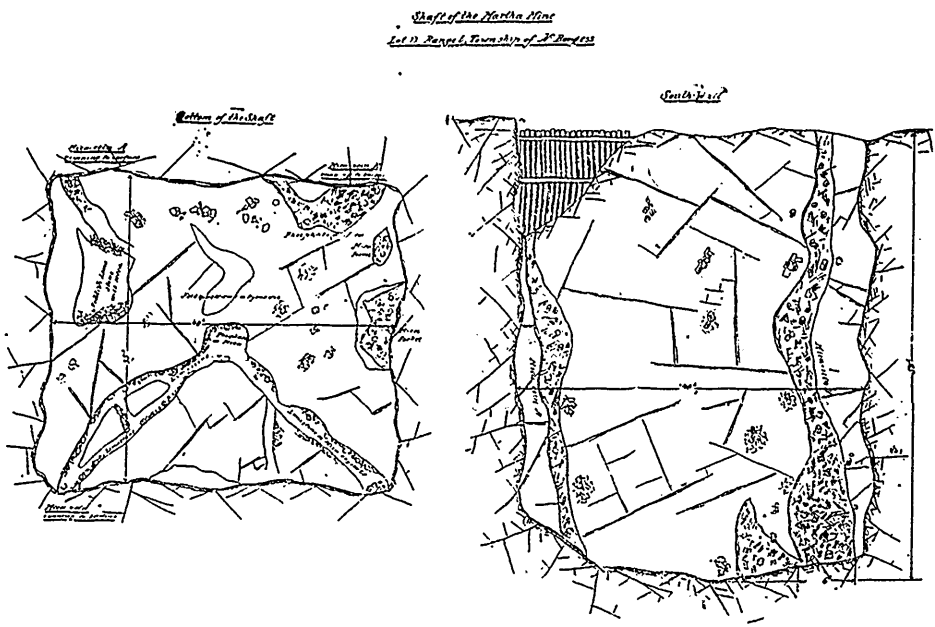
Interior of Cutting and Dressing Works of the Lake Girard Mica System, Ottawa.

"Drift H to the east has been continued for a length of 58 feet from the shaft middle and in a width expanding from 16 feet to 22 feet near the head-wall. The expected results, as described in my last report, with regard to the continuation of the deposit have greatly surpassed my expectations; not only is the vein continuing in regular width, but the quality and largeness of the crystals is improving the farther work is prosecuted to the east. Numerous crystals from half a foot up to 3 feet in diameter are distributed over the bottom head-wall and the roof. They are of very well defined characters, do not contain wrinkles or crevices, and yield a large quantity of commercial sheets. One crystal partly lying in the solid rock measured 2 feet 10 x 1 foot 6, one of the largest crystals of mica of good quality which has ever been found in the mining district of Ottawa. The vein has in the middle of the drift a width of eight feet and is split up near the head-wall in to two branches, each measuring six feet in width; the whole vein exposed shows a length of 34 feet.

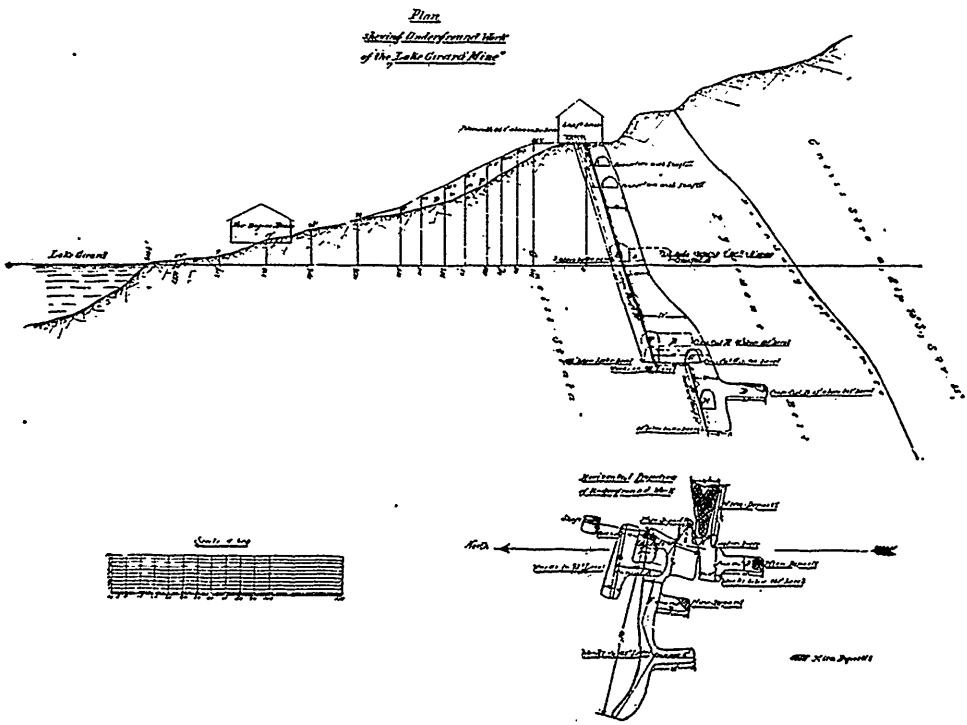
"There is no doubt that taking into consideration the length of this vein, the great distribution of crystals on the roof and in the bottom, the abundance of limestone as an essential companion of mica, that this deposit is a true fissure vein and is undoubtedly identical with the deposit discovered 40 feet higher in drift G of the 165 ft. level, thus giving the total dimensions of this vein to be 34 ft. long, 40 ft. high, and 8 ft. wide. Based on these measurements—not counting the extension of the deposit to the depth and to the east—the estimated quantity that can be raised very readily is 325 tons of large sized mica sheets. Beyond doubt this deposit will continue to the east and to the depth, and according to all appearances, the largest extension of the vein is not yet apparent.

CUTTING AND DRESSING FACTORY.

This commodious structure is located at 504 to 520 Besserer street, Ottawa. There are at present in use at the Lake Girard Mica System's factory twenty-three power presses for cutting irregular shaped discs and segments. These power presses are all of American manufacture; twenty of them from the E. W. Bliss Co., Ltd., of Brooklyn, N.Y., two of them are made by the Ferracute Machine Co., of Bridgeton, N.J., and the other manufactured by the Long and Allstatter Co., of Hamilton, Ohio. Eighteen of the Bliss machines are the well known Bench presses and specially suitable for cutting patterns most in demand at the present time. The dies used in this factory are the most



Plan VI.--Showing Occurrence of Mica in the Main Shaft of the Martha Mine, North Burgess.



Plan I.—Showing Underground Work at Lake Girard Mine.

complete at present in use for this purpose, and include some sixteen different patterns ranging in size from 5¼ x 10" to ⅞ x 3", and with a few exceptions are all made in Ottawa. The electric current used is supplied by the Chaudiere Electric Light and Power Co., of Ottawa. From this motor a dynamo is run which supplies light for the entire premises.

In addition to the cutting presses already mentioned, there are in use ten cutting shears for two-siding and cutting material of unusually large size.

During the past year there have been on an average of 70 men and women employed in this factory; the women's work is divided into three departments, viz:—Punching at the press, scribing mica for the shears, and cleaning and packing material for shipment. The other departments, in which the men are employed, is the splitting and culling when received from the mines, and cutting with shears.

From figures of the quantities shipped from the factory, supplied by the courtesy of the management, we gather the following:—

CUT MICA.

From September, 1891, to September, 1892, 55,824 lbs.; from September, 1892, to July, 1893, 66,140 lbs.

TRIMMED MICA.

From September, 1891, to September, 1892, 36,545 lbs.; from September, 1892, to July, 1893, 73,022 lbs.

An idea of the capacity of this factory can be gathered from the fact that during the months of January and February, 1893, 16,315 lbs. of cut mica and 12,292 lbs. of trimmed mica were prepared for shipment. The average monthly output has been in the neighborhood of 5,000 lbs. of cut, and 6,000 lbs. of trimmed mica, while the stock of mica on hand at date includes some 1,200 tons of merchantable mica and about 250 tons of material for grinding.

Stables at Ottawa—One of the most completely equipped stables in Ottawa is that belonging to the Lake Girard Mica System. This stable is situated on the same property as the Ottawa factory and storehouse, and is 85 feet long and 40 feet wide, with accommodation for forty horses. It is lighted by electricity from the dynamo in the factory, and is most complete in every respect.

THE MARTHA MINE.

Another property on which the Lake Girard Mica Mining System has done considerable work during the present season is the Martha mine, situated on lot 13, in the 6th range of North Burgess, County of Perth, Ontario. In the north portion of the property extensive mining work was carried on for about six months in shaft sinking, prospecting and general development work. The results obtained were satisfactory. The mica has proved of good merchantable value, and the indications point to a large production when the steam and air plant contemplated by the system has been put in. It is noteworthy that in the production of mica at this mine several hundred tons of apatite of high quality was raised, and this will undoubtedly form a valuable source of revenue when the present temporary depression in the phosphate business has passed away. The mine is equipped with suitable accommodation for a good working force, but the plant equipment is only of a preliminary character.

THE PIKE LAKE MINE.

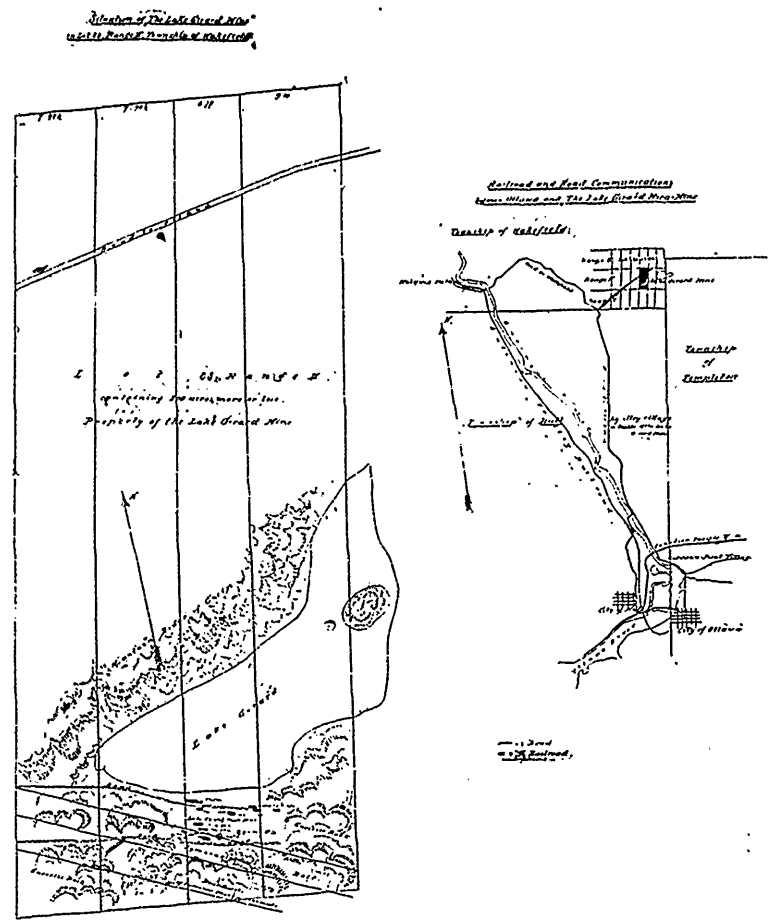
This is situated on the south half of Lots 16 and 17, in the 9th Range, township of North Burgess, county of Perth, and is about eight miles distant from Perth station on the main line of the Canadian Pacific Railway.

The most extensive opening is the shaft marked A on plan IV, which has a vertical depth of 65 feet. At a depth of 30 feet two parallel veins, at a distance of 8 feet from each other run across the shaft under an incline of 30 degrees, being apparently fissures filled with mica matter and crystals. The upper vein, having an average width of two feet, goes off into two small branch veins in the middle, and expands near the bottom of the shaft to a width of six feet. The latter shows crystals of silver mica in sizes of one foot six inches imbedded in pyroxene and pyroxene gneiss, and yielding a large quantity of well defined laminaes of commercial value. "According to all appearances," says Mr. Cirkel, "the vein expands in width considerably in the bottom of the drift, and will undoubtedly join in deeper levels with vein No. 2."

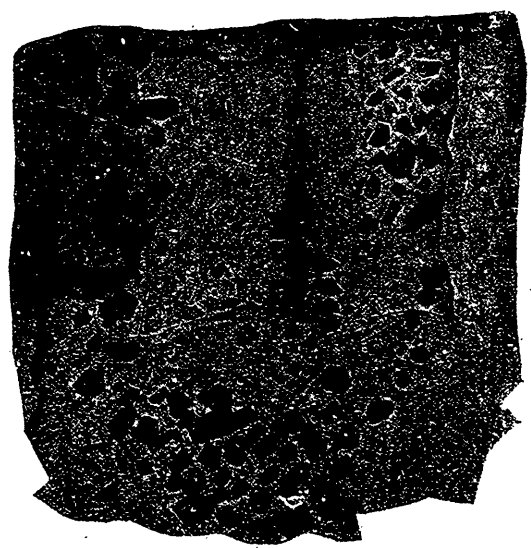
Vein No. 2 has an average width of one and a half feet, widens out in the middle to a pocket of irregular shape and shows near and in the bottom of the drift, crystals of well defined character. Besides these two veins several large sized pockets have been uncovered in drift "D" and many crystals distributed over the bottom indicate the presence of aggregates or pockets of mica in deeper levels. Small pockets have also been worked in the two drifts marked "A" and "B."

The bottom of the shaft and drift "C" could not be examined on account of being partially filled with water.

With regard to the prospects for this shaft they seem to me to be very good. Numerous mica crystals are to be found in the dump of the shaft as a sign for the richness of mica deposits; not less than about 50 tons of commercial mica have been won by cobbing over the dump. This fact, and the presence of two fissure veins and mica pockets in the south wall of the shaft, the great distribution of crystals over the bottom of the drift "D" gives, it seems to me, sufficient evidence for a richness of mica; and had the work of development been carried on, especially in drift "D" to the depth, the same amount of work would have furnished more data for above expressed opinion; but even as it is, it issuffi cient to show that this part of the pyroxenic belt is rich in mica deposits, and leads to the strong belief that other deposits will occur in the horizontal as well as in the depth. It may, therefore, be safely said that the average output of mica will be of considerable extent and value if the present slow and hand-power plant is replaced by a regular machinery plant of such capacity as to meet all difficulties caused by following the deposits to the depth. It is difficult to estimate the output in future, because no exact data as to the previous work in the shaft are to hand; but compared with other mica mines, and taking into consideration the large quantity of mica already taken out, and the mode of occurrence of the deposits, there should be no difficulty in raising by means of a plant of full capacity not less than one and a half to two tons daily.



Plan III.—Showing Location of Lake Girard Mica Mine.



Aggregation of Mica Crystals in Drift H, Lake Girard Shaft, from a Drawing by Mr. F. Circkel, M. E.

The Choice of Coarse and Fine Crushing Machinery and Processes of Ore Treatment.

By A. G. Charleton.*

Part III—The Cyanide Process.

The plant required for the MacArthur-Forrest process consists of crushers (stamps or rolls) to pulverize the ore to 20 to 60 mesh, and leaching and precipitating tanks of much the same description as those used for chlorination: but as its professed object is the treatment of the ore in bulk, the number of tanks, etc., required for this method of treatment are of necessity much larger than in chlorination works. The cost of erection of such a plant on a basis of treating 50 tons per day, would not, so it is said, ordinarily exceed £6,250, everything included.

The report of Mr. J. R. Bradshaw (assayer, etc., of Charters Towers), states, without going into details, that from information he received at Ravenswood, North Queensland, it can be worked there to profit at a cost of £2 per ton, but the cost must of necessity depend on the district and surrounding circumstances.

Mr. Bradshaw claims, moreover, economy for the process in regard to time occupied in treatment, as compared with raw amalgamation in pans, stating that with an ordinary wheeler, ½ ton of auriferous stone of about 2½ ounce grade is decomposed in 6 hours, representing the capacity of one wheeler as being equal to treating 12 tons per week. Mr. McIntyre, the company's manager at Ravenswood, he goes on to state, is erecting two wheeler pans, measuring 5 feet in diameter, capable of carrying a charge of 3 tons of ore each, and it will thus be seen that with two pans, 24 tons of ore can be decomposed in 24 hours.

It would be interesting to learn how those arithmetical calculations panned out in actual practice as regards power consumed and other details.

A test of the Ravenswood ore made by Mr. Bradshaw gave an extraction of 89 per cent. of the gold and 70 per cent. of the silver.

If the success of the process demanded the mechanical incorporation of the cyanide solution with the ore in pans, it would seem likely to be foredoomed to failure, and on this account the idea is now almost entirely abandoned.

It would probably be found that, for convenience and speed, barrels could be advantageously substituted for pans, but modern developments of the process have done away with the original notion of auxiliary agitation.

The Chemistry of the Cyanide Process.

This has been ably dealt with by Messrs. Charles Butters, Ph.D., and J. E. Clennel, B. Sc., in a series of papers which appeared in the New York *Mining Journal*, in October last, from which the following extracts are taken:—

Elsner has shown that the very finely divided gold obtained by precipitating a solution of the chloride with ferrous sulphate may be dissolved by potassium cyanide, provided there is an excess of oxygen present.

The compound formed may be looked upon as a double cyanide of gold and potassium (KCyAuCy), and the reaction which takes place may therefore probably be represented by the following equation:—

$$2Au + 4KCy + O + H_2O = 2KAuCy_2 + 2KHO.$$

Two interesting points are indicated by the above equation, which it is well to bear in mind, in applying potassium cyanide as a good solvent on a commercial scale.—

1. That the quantity of cyanide theoretically capable of dissolving a given amount of gold is infinitesimal, compared with the weight actually required in practice. Taking Au = 196·8, K = 39·04, and Cy = 25·98, it will be observed that 130·04 parts by weight of potassium cyanide should be capable of dissolving 196·8 parts of gold, or approximately two parts of the cyanide salt should dissolve three parts of gold. The minimum actual consumption in treating free-milling ore, assaying, let us say, 10 dwts. per ton, is about 3 lbs. per ounce of gold recovered, or roughly, forty parts by weight of cyanide for one part of gold. In the leaching-tanks alone 1 lb. of cyanide is generally consumed per ton of material treated.

2. That an extremely small quantity of surplus oxygen is sufficient to cause the solution of the gold, 15·96 parts being required for 393·6 parts of gold, or say as 1 : 25. The air present in a porous mass of tailings, with that dissolved in the water used in making up the solution, is in fact more than ample to effect the reaction. To explain the enormous excessive consumption of cyanide, we must bear in mind the great instability of the simple cyanides.

Hydrocyanic acid is liberated from its salts by all mineral acids, carbonic acid, and all common organic acids. Atmospheric carbonic acid is sufficient to set up a certain amount of decomposition, in which a constant evolution of hydrocyanic acid takes place as follows:—

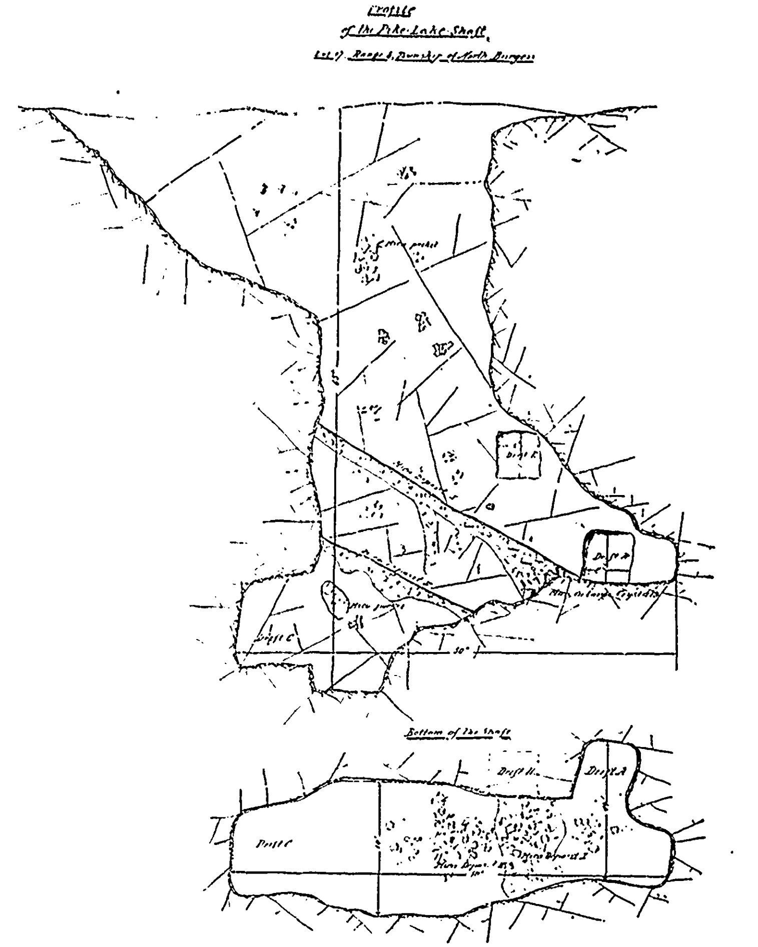
$$2KCy + CO_2 + H_2O = 2HCy + K_2CO_3.$$

Then, again, we must consider the proneness to oxidation which the cyanates exhibit, and which in fact lies at the base of most of their technical applications. Potassium cyanide readily changes into cyanate and ultimately into carbonate:—

$$KCN + O = KCNO;$$
$$2KCNO + 3O = K_2CO_3 + CO_2 + N_2$$

The presence of alkalies, which always occur in commercial cyanide, tends to induce the peculiar and little understood decomposition termed hydrolysis, which seems to be mostly produced in the zinc boxes by the presence of that metal.

*Transactions of Fed. Inst. of M. and M. E.



Plan VII.—Profile of Main Shaft at Pike Lake Mica Mine, North Burgess, Ont.

In the reaction alluded to above, the alkali appears to determine a chemical change, in which water plays a part, while the alkali itself is not in the least affected.

There are good grounds for supposing that in dilute solutions a dissociation of the cyanide takes place, so that what we term a weak solution of potassium cyanide is in reality a mixed solution of potassium hydrate and hydrocyanic acid:—

$$H_2O + KCy = HCy + KHO.$$

This being the case it is only natural that hydrocyanic acid should be constantly given off from all vessels in which weak cyanide solutions are freely exposed to the air, and its smell is, in fact, generally noticeable in the neighbourhood of the tanks in which it is stored.

The consumption of the reagent is on these grounds evidently enhanced by the agitation or circulation systems, since these methods involve a constant exposure of fresh surfaces.

Another source of waste is due to the tendency of the simple cyanides to form double salts with each other, or with other metallic compounds.

Salts of iron, and to a lesser extent of aluminium, magnesium, calcium, and the alkali metals are liable to occur in the tailings, especially after long exposure to atmospheric influences.

It seems, therefore, that under the most favourable circumstances an enormous waste of cyanide must take place, which may partly, however, be mitigated by the use of closed tanks and careful attention to the purity both of the cyanide itself and the water employed to dissolve it.

Action of Cyanide or Pyritic Material—Various additional decompositions take place, when cyanide is applied to the treatment of pyritic ores or tailings. The surface ores of the celebrated banket formation of South Africa consists almost exclusively of silica and oxide of iron, the silica occurring in the form of rounded pebbles, embedded in a softer matrix highly charged with ferric oxide, which gives it a characteristic reddish tinge. The gold* is found in this matrix associated with the oxide of iron, or sometimes in small scales on the surface of the pebbles. The pebbles themselves carry little or none.

At a lower level this free-milling banket passes into an ore precisely similar in structure, but much harder, and containing the iron in the form of sulphide instead of oxide, which gives it a peculiar bluish tint.

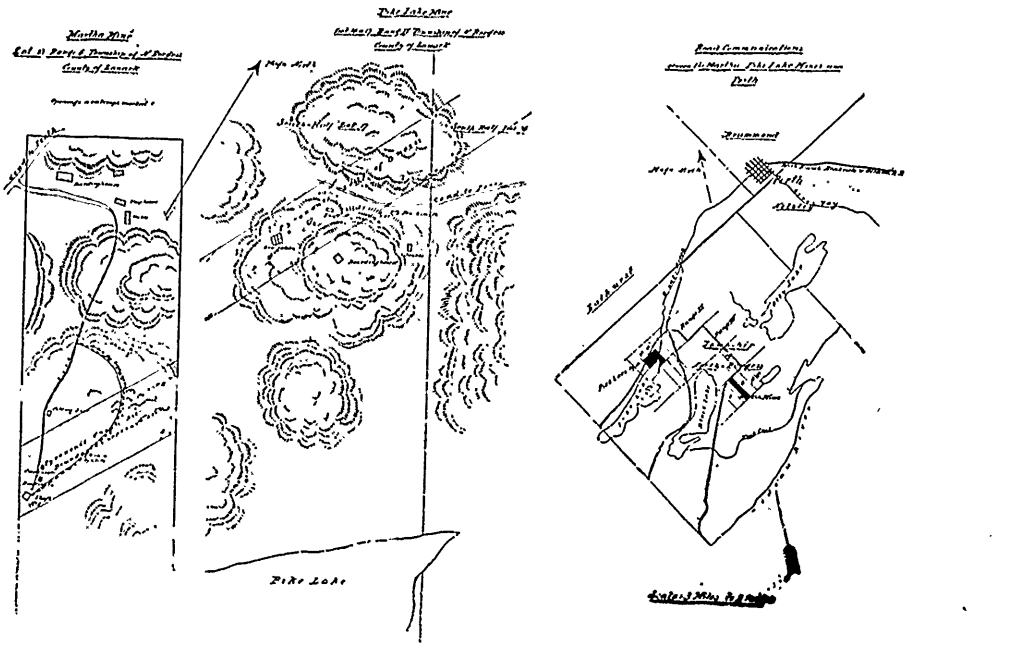
There can be no doubt that the free-milling ores have been formed by the gradual oxidation of the pyrites through the influence of air and moisture during a long period of time, and in fact we see this change in progress, wherever pyritic material has been exposed to the action of the atmosphere. The first effect observed is the conversion of ferric sulphide into a soluble sulphate, free sulphuric acid being liberated. By the action of the air again on the ferrous sulphate, certain insoluble basic sulphates of variable and somewhat complex composition are found to result, whilst a certain amount of soluble ferric sulphate is likely to be produced at the same time.

The pyritic ores or the Witwatersrandt contain also small amounts of copper, arsenic, and sometimes cobalt and nickel, but the amount of these foreign metals has hitherto been so small that it has not practically interfered with the process.

As the fact has been observed, however, at the Robinson chlorination works, that copper and arsenic seem to occur in gradually increasing quantities with the increasing depths of the mines from which these concentrates were purchased, it is possible that these elements may be a serious source of trouble in the future.

If one attempts to treat a charge partially oxidized pyritic tailings directly with cyanide solution, the free

* *Taking into account the production from tailings and concentrates* the average yield of the Witwatersrandt ore was 12 dwts. 5 grains per ton in 1891 and 12 dwts. 13 grains in 1892. At the end of 1891 there were 1,540 stamps in operation, which yielded 11·23 dwts. per ton by direct amalgamation, whilst the average of free-gold saved fell in 1892 to 9·87 dwts., 2,035 stamps being in operation at the close of the year; the total yield having increased rather than fallen off goes to show that though the ore with depth has become more sulphuretted, it has so far been successfully treated.



Plan V.—Showing location of Martha and Pike Lake Mica Mines, North Burgess, Ont. (from drawings by Mr. F. Cirkel, M. E.)

sulphuric acid present which renders the moisture they contain distinctly acid, sets free hydrocyanic acid. Ferrous sulphate (green vitriol) reacts upon the cyanide with the formation of ferrous cyanide, a yellowish-red flocculent precipitate :—

$$FeSO_4 + 2KCy = FeCy_2 + K_2SO_4.$$

This, however, under ordinary circumstances is slowly converted into potassium ferrocyanide by the excess of cyanide present :—

$$FeCy_2 + 4KCy = K_4FeCy_6.$$

If sufficient acid be present, the ferrocyanide reacts on an additional quantity of the ferrous salt, ultimately giving rise to a blue precipitate or coloration (Prussian blue) :—

$$3K_4FeCy_6 + 6FeSO_4 + 3O = Fe_2O_3 + 6K_2SO_4 + Fe_7Cy_{18}$$

A coloration of that sort on the surface of the tailings or in the solution is therefore a sure indication that acid iron salts are present, and that a large waste of cyanide is taking place.

Ferric salts, when present unmixed with any ferrous compounds, decompose the cyanide solution with evolution of hydrocyanic acid, and precipitation of ferric hydrate :—

$$Fe_2(SO_4)_3 + 6KCy + 6H_2O = Fe_2(OH)_6 + 6HCy + 3K_2SO_4.$$

This reaction takes place in two stages, the first being the formation of a soluble but very unstable ferric cyanide, giving a dark brown solution :—

$$Fe_2(SO_4)_3 + 6KCy = Fe_2Cy_6 + 3K_2SO_4,$$

which decomposes as follows :—

$$Fe_2Cy_6 + 6H_2O = Fe_2(OH)_6 + 6HCy.$$

This gives rise to ferric hydrate part of which, being in a finely divided colloidal condition, is with difficulty removed, as it chokes the pores of the filters.

A mixture of ferrous and ferric sulphates, such as is probably always present in partially oxidized pyritic tailings, causes the appearance of a blue colour on the addition of cyanide, after the free alkali of the commercial product has been neutralized, Prussian blue (ferric-ferrocyanide), $Fe_4(FeCy_6)_3$, being produced when the ferric salt is in excess, and Turnbull's blue (ferrous-ferricyanide), $Fe_3(FeCy_6)_2$, when the ferrous salt predominates.

Before attempting to treat pyritic material or products with cyanide, it is necessary therefore to get rid of the free sulphuric acid and soluble iron compounds. This is generally done by leaching with water until the liquid running off the tanks no longer shows a coloration with ammonium sulphide. After this treatment the insoluble basic sulphates which still remain, and being gradually decomposed by water, would act upon the cyanide solution, are dealt with by washing with caustic soda or lime water. This converts the basic salts into ferric hydrate and sodium or calcium sulphates. When the quantity of free acid and iron salts is small, the preliminary washwater may be advantageously omitted.

Lime in the dry state is sometimes mixed with the tailings before the cyanide treatment commences. When this method is adopted the iron is precipitated as a mixture of ferrous and ferric hydrates. After the washing with alkali is completed, the tanks are allowed to drain, and strong cyanide solution of about 6 per cent. is pumped on.

Even after this treatment the consumption of cyanide with moderately pyritic tailings, which have been partially decomposed by exposure, is found to be four times that which occurs with free-milling material.

The presence of a large excess of alkali in the solution brings about various secondary reactions, which lead to a loss of cyanide, such as the hydrolysis before referred to, and a peculiar action in the zinc box mentioned later

Lime though slower in its action is preferable to caustic soda as a neutralizing agent, as it is equally effective in decomposing the iron salts, less active in producing secondary reactions on the cyanide, and also less energetic in attacking the zinc in the precipitating-boxes.

Ferric hydrate does not appear to be acted upon by potassium cyanide, but ferrous hydrate, which is formed on the neutralization of the iron salts by alkalies, reacts on the cyanide in excess, with the formation of ferrocyanide of potassium :—

$$Fe(OH)_2 + 6KCy = K_4FeCy_6 + 2KOH.$$

Deposition of Gold from Cyanide Solutions.—Under certain conditions, such as the absence of sufficient oxygen in the solution, a partial precipitation of the previously dissolved gold appears to occur. If by any chance the solution should become acid, there is a decomposition of the double cyanide of gold and potassium, in which the gold is generally supposed to be thrown down as (insoluble) aurous cyanide :—

$$KAuCy_2 + HCl = KCl + HCy + AuCy.$$

In working on the circulation-and-transfer system it is found that where pyritic material is under treatment it is not safe to transfer a solution already rich in gold to a fresh lot of tailings, as the extensive decomposition of the solution which takes place may lead to a final loss of gold.

Selective Action of Cyanide.—It is claimed by the inventors of the MacArthur-Forrest process, that in a mixture containing metallic gold, silver, copper, and base metals, cyanide of potassium exerts a selective action, dissolving first the gold, then the silver, and afterwards attacking the copper and baser metals.

The process, however, does not appear to have been successfully applied to ores, such as are met with in parts of California and Australia, containing considerable quantities or foreign metals.

Ores containing sulphides of silver and copper produce considerable decomposition of cyanide, the copper being partially dissolved as subsulpho-cyanide, the silver, however, remaining unattacked.

In two experiments carried out by Mr. Wm. Bettel, chief chemist of the Robinson Gold Mining Company, on an ore from the Albert silver mine (containing 30 ounces of silver per ton and 10 per cent. of copper), it was found that no extraction of silver occurred, this metal being present as sulphide.

Action of the Zinc Shavings on the Solution.—We must now consider the action of the zinc on the gold cyanide solution. Theoretically, a simple substitution of zinc for gold occurs in accordance with the following equation :—

$$2KAuCy_2 + Zn = K_2ZnCy_4 + 2Au.$$

Taking Zn=65·1, Au=196·8, it follows that 65·1 parts by weight of zinc should be sufficient to precipitate 393·6 parts of gold, or 1 lb. of zinc should precipitate 6 lbs of gold. The actual consumption of zinc is about 1 lb. per troy ounce of gold recovered. It is evident, then, that zinc is consumed in some other way than in mere replacement of gold.

During the passage of the solution through the zinc boxes a constant vigorous evolution of small bubbles may be noticed, which are found to consist chiefly of hydrogen. The outflowing liquid is found to possess a greater degree of alkalinity than it had on entering at the head of the box, and a smell of hydrocyanic acid and sometimes of ammonia is constantly observed in the neighbourhood of the boxes.

It is clear, then, that a decomposition of the potassium cyanide solution itself by the zinc is in progress, and this is not to be wondered at when we consider the powerful electro-chemical effect which must be produced by the contact of such a highly positive metal as zinc with a strongly negative metal such as gold.

Ordinary commercial zinc loses weight when immersed for some time in cyanide solution, but the action is slow. It is doubtful whether pure potassium cyanide would have any action at all on chemically pure zinc. It is well known that the copper-zinc couple produced by immersing zinc in a solution of a copper salt decomposes water.

An analogous reaction of the zinc couple accounts for the evolution of hydrogen above-mentioned :—

$$Zn + 2H_2O = 2H + Zn(OH)_2.$$

The hydrate of zinc is at once dissolved in the excess of cyanide :—

$$Zn(OH)_2 + 4KCy = K_2ZnCy_4 + 2KOH,$$

which reaction accounts for the increased alkalinity of the solution.

There are reasons for believing that the black deposits formed on the zinc shavings is an actual chemical compound of gold and zinc, which acts as the negative element in the electric couple, the undecomposed zinc forming the positive element.

When strong solutions of caustic soda have been used for neutralizing the acid salts of the ore, a white deposit is frequently observed on the zinc. The alkali first attacks the metal to form a zinc-sodium oxide :—

$$Zn + 2NaHO = Zn(ONa)_2 + 2H.$$

This then reacts on the double cyanide of zinc and potassium always present in the solution, and precipitates the white insoluble simple cyanide of zinc :—

Cantley Stables of the Lake Girard Mica Mining System.

$$2H_2O + Zn(ONa)_2 + K_2Zn(Cy)_4 = 2Zn(Cy)_2 + 2NaOH + 2KOH.$$

This reaction is of some importance as affording one means by which the excessive accumulation of zinc in the solutions is avoided.

Affinity of Zinc for Cyanogen.—Potassium auric cyanide ($KAu(Cy)_4$) appears to be one of the most stable of the salts of gold, and the reaction in the zinc boxes, shows that the affinity of zinc, together with potassium, for cyanogen, is greater than that of gold with potassium for the same radicle. Hence a solution of potassium cyanide cannot dissolve gold which is in contact with zinc, neither can gold replace zinc in a solution of the double cyanide of zinc and potassium. So long as any zinc is present, therefore, we need not fear that the precipitated gold will redissolve in the excess of potassium cyanide flowing through the boxes.

It is evident also that the cyanogen contained in the double cyanide of zinc and potassium is not available for dissolving gold, nor when a solution charged with zinc is employed in the treatment of a fresh lot of tailings it is only effective in so far as it contains a certain quantity of simple cyanide of potassium or other alkaline cyanide.

New Methods of Precipitation.—The cyanides of sodium and ammonium and those of the alkaline earths (calcium, barium, etc.) will dissolve gold as well as potassium cyanide. Sodium cyanide is more difficult to manufacture than the potassium compound, but a given weight of it should be more effective than the same weight of potassium cyanide, inasmuch as 49 parts of the former are equivalent to 65 of the latter.

The advantages of Molloy's process and others which employ sodium or potassium amalgam will be referred to later. The alkali metal is obtained by the electrolysis of the carbonate between electrodes of lead and mercury :—

$$Na_2CO_3 = Na_2 + CO_2 + O.$$

The sodium forms an amalgam with the mercury. Sodium amalgam may also be manufactured direct from its elements. It is claimed for this method of precipitation that the whole of the cyanogen is restored to a condition available for dissolving gold as shown by the reaction :—

$$Na + KAuCy_2 = Au + KCy + NaCy.$$

Composition of the Zinc Slimes.—Any base metals which happen to be in solution in the cyanide liquor are liable to be precipitated by the zinc along with the gold. Hence the zinc slimes are found to contain a certain percentage of copper as well as traces of arsenic and antimony. Moreover, any impurities in the zinc will also find their way into the slimes, as zinc will be dissolved by the cyanide in preference to any less oxidizable metals, *e.g.*, tin and lead. Silver is dissolved by the cyanide and re-precipitated by zinc by a set of reactions precisely analogous to those of gold :—

$$2Ag + 4KCy + O + H_2O = 2KAgCy_2 + 2KOH, \text{ and}$$
$$2KAgCy_2 + Zn = K_2Zn(Cy)_4 + 2Ag$$

It has been observed that the proportion of silver to gold is greater in the cyanide bullion than in the gold from the batteries, and this is explained by supposing that the loss of silver in amalgamation is greater than that of gold.

Treatment of the Zinc Slimes.—The removal of the zinc is a troublesome operation, and is only very partially carried out in smelting the dried slimes. The admixture of sand is made for the purpose of forming a fusible silicate of zinc.

A portion of the zinc is volatilized and burns at the mouth of the crucible with a greenish flame, producing the white oxide (ZnO), which is found encrusting the flues, and no doubt carries with it no inconsiderable quantity of gold and silver. The most promising method of treating these slimes appears to be that suggested by Mad Bettel of fluxing with acid sulphate of soda and fluorspar.

Attempts to remove the zinc prior to smelting have been only partially successful, as all such methods involve the filtration of a slimy mass, which retains soluble salts with great tenacity.

The slags from the fusion of the zinc slimes contain a considerable amount of gold, some of which is in the form of round shot, and may be removed by pounding up the slag, passing through a course sieve, and panning off. The residue from the first fusion should always be fused again with additional lead to form an alloy with the gold. The same lead bars may be used for a number of successive fusions of the slag, and when sufficiently enriched the gold can be recovered by cupellation.

Testing of Cyanide Solutions.—It is a matter of importance to determine exactly what strength of cyanide solution is used in treatment of tailings. The ordinary method of testing depends on the fact that silver cyanide is soluble in excess of potassium cyanide, with the formation of a double cyanide of silver and potassium :—

$$KCy + AgNO_3 = AgCy + KNO_3, \text{ and}$$
$$AgCy + KCy = KAgCy_2$$

When silver nitrate solution is added drop by drop from a burette to a solution of cyanide a white precipitate is formed, which quickly redissolves. At a certain stage the precipitate becomes permanent, when, in fact, the whole of the cyanide has been converted into the soluble silver salt, and an additional drop of silver nitrate produces a permanent precipitate of the insoluble simple cyanide of silver :—

$$KAgCy_2 + AgNO_3 = KNO_3 + 2AgCy.$$

From these reactions 107·66 parts by weight of silver are equivalent to 130·04 parts of potassium cyanide. A convenient standard silver solution is one of such strength that every cubic centimetre added to 10 cubic centimetres of the solution to be tested, corresponds to 0·1 per cent. of pure potassium cyanide.

This method gives good results when pure cyanide solutions are under examination, but when the solutions contain zinc it is difficult if not impossible to determine the end of the reaction. A white flocculent precipitate occurs at a certain stage, probably consisting of simple (insoluble) cyanide of zinc, formed by the decomposition of the soluble double cyanide.

This precipitation occurs long before the whole amount of potassium cyanide has been converted into the soluble double salt of silver ($KAgCy_2$) for the solution after the appearance of the flocculent precipitate still gives the Prussian blue reaction with acidulated ferrous sulphate.

A standard solution of iodine in potassium iodide may be used with great accuracy for determining the total amount of cyanogen in a solution whether in combination with zinc or not, making use of the reaction :—

$$KCy + I_2 = KI + ICy.$$

The colour of the iodine is discharged so long as an excess of cyanide is present. The sharpness of the terminal reaction may be increased by adding a small quantity of starch to the solution under examination, which gives a permanent blue colour as soon as an excess of iodine has been added.

What is most needed, however, is a rapid method of determining the amount of cyanide available for dissolving gold, for, as was pointed out above, the cyanide in combination with zinc is not available for that purpose.

The method of testing solutions containing zinc for available cyanide which was introduced by Mr. Bettel at the Robson Company's works is as follows: Two perfectly clean flasks of equal size are taken. To each of these is added a considerable bulk, say 50 cubic centimetres of the solution to be tested and 50 cubic centimetres of water. The liquid in both flasks will probably appear slightly turbid, but the degree of turbidity will be the same in each. Standard silver nitrate solution is run into one flask until the slightest possible increase in turbidity is observed in comparison with the liquid in the other flask. This point is taken as indicating the conversion of the whole of the free potassium cyanide into the soluble silver salt, and therefore as determining the amount of available cyanide present.

The amount of gold in the solution is generally found by evaporating a known bulk with litharge, fluxing the residue and cupelling the resulting lead bullion. Evaporation on lead foil may likewise be employed.

Poisonous Properties of Cyanide.—A few words may not be out of place in this connexion. Although one of the most rapidly and deadly of known poisons when taken internally, its action as a blood poison is much less violent. Nevertheless, when introduced into cuts it produces very painful sores. The men employed in cleaning-up and in melting the slimes are subject to a peculiar eruption, especially on the arms, and complain of headache, giddiness, and general depression.

Ferrocyanide of potassium has been recommended as a remedy for the eruption; it may be taken internally and also applied as a lotion. Considering the dangerous nature of the reagent it is remarkable how few fatal cases have occurred through the use of cyanide on a large scale. In cases of poisoning precipitated carbonate of iron, obtained by mixing solutions of sodium carbonate and ferrous sulphate, may be used as an antidote, forming internally an insoluble blue compound with the cyanide.

Hydrocyanic acid acts directly on the nervous system, causing instant paralysis, hence any treatment which will excite the action of the nerves such as applications of cold water to the spine, inhalation of ammonia, etc., may be tried in cases of faintness produced by breathing the acid vapour.

The disposal of waste cyanide liquors is a matter of serious consideration. Solutions containing 0·1 to 0·2 per cent. of potassium cyanide must occasionally be discharged and are likely to contaminate the water of the dams or streams which receive them to a dangerous extent. If some effective means of precipitating the zinc, or better still of dispensing with the use of zinc altogether, could be devised there would never be any necessity for allowing cyanide liquors to the works.

APPLICATIONS OF THE CYANIDE PROCESS.

Mr. Almarin B. Paul appears to have originated the idea of using cyanide solution in the battery crushing the ore wet. This he claims to have done with success at the Calamut mill, Shasta County, Carlifornia. He states that his plan is in all cases to crush with a weak solution, and should the ore require a higher percentage of cyanide when the first solution has percolated below the surface of the ore, after the tanks have been filled, a stronger one can, if necessary, be introduced. All the dust and disagreeable effects of dry-crushing is thus avoided. The loss of cyanide in crushing is but nominal, and is off-set by the cheapness of working and completeness of distribution of the cyanide through the pulp in the tanks. This plan has been followed of late at the May Consolidated works in South Africa, but it does not appear to be applicable to all cases, as generally when ores have been crushed wet and run direct to the tanks the pulp has packed so hard as to be impenetrable to the leach liquor. Ores containing impurities, such as arsenic and tellurium, have proved obstinate to deal with.

The consumption of available potassium cyanide may for practical purposes be divided into avoidable and unavoidable decomposition; each of these factors varying with the composition of the ore, the strength of the solution, time of contact, and method of treatment.

Tests made on a heavy, raw sulphide gold ore by Mr. C. W. Merrill, using a 2 per cent. solution, showed that it was capable of decomposing available cyanide at the rate of 12 lbs. per ton in 24 hours, but that by taking all possible precautions this loss could be reduced to 3 lbs. per 24 hours.

The reduction in loss of cyanide seems, however, to have been set off by an extravagant loss of time, as it is necessary to continue the treatment for 7 to 10 days.

A series of extraction tests proved that a ¼ per cent. solution when reinforced each day gave as good results as a stronger one, and with a decomposition of only 5 to 7 lbs. of cyanide per ton. As the ore contained acid salts of iron and fine copper sulphides, both of which decompose potassium cyanide, the probability is that the weak solutions were rendered inert after a few hours' contact with the ore, hence the necessity of reinforcing them.

A series of experiments, published in detail in the *New York Mining Journal* of December 24th, 1892, were made by Mr. G. E. Kedzie, M.E., to determine how far the gold bearing pyritic ores of Ouray, Colorado, could be successfully treated by the cyanide process, and also to learn the conditions under which the most complete extraction could be obtained, together with the amount of cyanide consumed. These experiments throw much light on the question of how far it is practicable to treat ores of a similar description by the cyanide method.

The samples under treatment contained gold and silver in varying proportions, ranging from 0·27 ounce to 145·90 ounces of the former, and 0·65 ounce to 458 ounces of the latter metal, the value of the high-grade ores and tailings being determined by triplicate scorificati n assays, and that of the low grade ores and tailings by duplicate crucible fusions. The gangue in some cases was quartzose, in others calcareous or clayey, and contained iron pyrites, copper pyrites, and magnetite, either alone or in admixture.

(To be Continued).

QUARTERLY MEETING

OF THE

Mining Society of Nova Scotia.

FULL REPORT OF PROCEEDINGS

The September Quarterly meeting of the Society opened at Halifax, on Thursday, 28th instant. Among those present were: Messrs. H. S. Poole, M.A., F.G.S., Stellarton; John E. Hardman, S.B., M.E., Oldham; J. H. Austen, Halifax; R. H. Brown, Sydney Mines, C.B.; Charles Fergie, M.E., Westville; F. H. Mason, F.C.S., Truro, W. R. Thomas, Montague; A. A. Hayward, Waverley; B. C. Wilson, Waverley; Dr. E. Gilpin, Jr., Inspector of Mines, Halifax; Howard Clarke, Halifax; George W. Stuart, Truro; A. Drysdale, Halifax; Geoffrey Morrow, Halifax; H. M. Wylde, Halifax. Messrs. S. P. Franchot, Buckingham, and B. T. A. Bell, Ottawa, officers of the General Mining Association of the Province of Quebec, were also present as delegates from that organization.

Mr. H. S. Poole, President, in the chair.

The minutes of previous meeting having been confirmed and Mr. A. Dick, Joggins Mines, having been elected a member, the meeting adjourned until the afternoon.

The Introduction of New Mining Legislation—Interview with Premier Fielding.

A deputation, consisting of the President and eight members, waited upon the Hon. W. S. Fielding, Premier of the Province, at his office in the Government Building, at 12 o'clock.

MR. POOLE stated that the object of this visit by the members of the Mining Society, was in respect to mining legislation—legislation which is introduced as a casual matter into the House. He asked that an opportunity be given so that all sides of the question might be presented to the Government. A good deal of mining legislation had been introduced into the House, without the opportunity being given to those who are engaged in mining, of discussing it. He would submit that it should be an unwritten law, that all legislation respecting mining should pass through the Mines Department.

MR. FIELDING replied that the Government cannot put any restriction upon any member of the House introducing legislation respecting mining. In matters of importance respecting mining legislation the endorsement of the Department of Mines should be obtained. If it were proposed that the Government should interfere with the liberty of action of any member to bring forward legislation, that he could not assent to.

MR. POOLE—There can be an unwritten practice—a private member may have a perfect right to bring in any amendment he pleases, but the Government could say: "You cannot expect the Government to consider this carefully or endorse it, unless it has had an opportunity of having it discussed by those it is going to affect."

MR. FIELDING—That implies that no legislation is to be introduced without being considered and endorsed by the Government.

MR. POOLE—In the matter of education does not the Government control all amendments touching education?

MR. FIELDING—Our system has settled down now—to a general extent, any amendment of importance to the education law is brought forward by the Government, but all amendments do not emanate from the Government, but from private members as well. If you mean that you would like to urge, not as a practice, but as a reason, that all mining legislation should be considered and not done hastily, I fancy that merely passing through the Department would not satisfy you—the Department is not infallible. I assume you would like to know what was going on, and that you should have an opportunity to present your views.

MR. POOLE—It would lead to that.

MR. HARDMAN—Legislation which may appear on the surface as all right, and, therefore, not specially attract the attention of the Commissioner of Mines, might have an effect very apparent to a person in the profession. If we had an opportunity of knowing in due season, what legislation is proposed, we might have a voice in the matter. I will simply mention one case which occurred last winter, the changing of the courses from the true meridian to that of the magnetic meridian.

MR. FIELDING—If that was a mistake, it was done without the consideration of the Department. The Department may not have had it under full consideration. It may have been in consequence of being introduced late in the Session. You wish to have an opportunity to present your views from the standpoint of practical miners—that I take it is the main point you urge.

MR. HARDMAN—Yes; but specially refer to the amendments brought forward by private members. We desire a chance to know what legislation is introduced, and a chance to present our objections if we have any.

MR. FIELDING—The general principle you lay down, therefore, is that mining legislation should not only receive the attention of the Department of Mines, but that the miners of the country should have a chance of a hearing? All that I agree to.

MR. POOLE—There are many existing inconsistencies, e.g.. Why should a boy in a coal mine have shorter hours than a boy in an iron mine? New Zealand apparently took the English act and copied whole sections from it, making restrictions of the hours concerning boys, and wound up by saying "No boy shall be employed in any capacity."

MR. FIELDING—This may not have been the intention of the Act. You must not imagine that if you have the supervision of the Mines Department and a chance to discuss the Act that this will prevent any errors creeping into legislation affecting mines. The best of draughtsmen may be employed in framing an Act and yet millions of dollars may be spent in finding out what certain sections of an Act means. For instance, take the Liquor License Act of Canada.

MR. HARDMAN—A judgment was given in Quebec not more than twelve months ago to the effect that all persons are obliged, under an Act, to have a powder magazine with walls of masonry and a roof of iron.

Admitting the fact that no body of men can make perfect laws, still would it not be better to have a chance to discuss measures which are brought forward.

MR. FIELDING—Quite so.

If you gentlemen agree among yourselves and furnish us with a memorandum of the amendments you propose we will endeavour to entertain them. I fancy some will be subject to contention, yet some palpable errors may be removed. If some of your members were to make a list of the amendments you propose, not the amendments themselves, but the substance of them, we may have an opportunity of eliminating errors in the Act—do not wait until Parliament meets for some suggestion—and do not take it for granted that everything you ask for will be given. We do not want to impose upon you the duty of revising our mining law; that is our business. If you furnish us with a memorandum of what your society considers defects in our law, and a statement of what amendments should be made, it would be in order. The Government would then reframe the Act.

MR. HARDMAN—We simply came as petitioners to ask the attention of the Government, to obviate as far as possible all future errors which may be made. The examples we have cited are of what has been done in the past. We wish also to call attention to one other matter—formerly it was the custom, under an old Act to keep a record of the different mine workings, in the Mines Office.

DR. GILPIN—I might simplify matters by stating that I think you are mistaken as to the authority of an Act.

MR. POOLE—If it was not in accordance with the Act, it was in accordance with the practice of the office.

MR. FIELDING—Gold mines chiefly?

MR. HARDMAN—All metal mines.

MR. POOLE—Now, we would like to see some record kept, and a memorandum published from time to time of the depths of the workings; also of the extent of the workings in this and that district, etc., which could be amended from year to year as the workings progressed.

DR. GILPIN—Would you extend that further to locate the position of such shafts?

MR. POOLE—Yes.

MR. HARDMAN—I have nothing more to say in suggesting anything to the Government, but I will beg that the Mining Society should have the fullest opportunity of a public hearing, in order to show Parliament whether a measure was advantageous or disadvantageous in the judgement of those affected by such legislation.

In regard to the plans of deep workings, I submit that such plans would be of more value to the Province than to the individual.

MR. FIELDING—But I should think it would be desirable during the session for the Society to have one of its members present watching against wrong doing

MR. HARDMAN—A lobbyist?

MR. FIELDING—I anticipated your suggestion. I am not imposing such duty upon you, but I would suggest that a member of the Mining Society should watch closely the daily newspapers, and the moment he saw that any mining legislation was introduced, he could get a copy. It would not mean a lobbyist; it would simply mean an observer.

MR. HARDMAN—In 1885 such matters could be brought before the Mines Department, and a public hearing could be obtained.

MR. FIELDING—I think there should not be much difficulty in watching the newspapers, and getting copies of any measures introduced into the House, for your own protection I think you would find it useful. I would not impose this on you as an obligation but for your protection.

MR. HARDMAN—In spite of that watchfulness, somebody would come in with a private bill which would have the effect we complain of. I tried to do as you suggest last session, but the special matter of the "meridian" already mentioned, had already reached its final stage, and I was too late

MR. FIELDING—This bill must have passed through some critical stage.

DR. GILPIN—Some people came to Mr. Church and made representations——

MR. HARDMAN—(interrupting)—That is the very point we are driving at. "Some people," not representing the industry, made "representations" to the Commissioner, and he acceded to them without giving us a hearing. As a matter of fact, this amendment means that the surveyors you have in the Province are too lazy to get the true meridian, and instead, prefer laying a magnetic course. It is a serious matter, for we have had various instances where the variation of compasses has caused direct loss and litigation. The matter of changing to the true meridian was thoroughly threshed out by the Society's predecessor, the Gold Miners' Association, and the change to true meridian received the unanimous endorsement of the Gold Miners' at that time.

MR. FIELDING—I formed the impression at the time that it was a mistake and it should be corrected. From what you tell me, it is against the opinion of the Mining Society?

MR. HARDMAN—The matter was threshed out in the Gold Miners' Association, and was recommended by that body for adoption.

MR. FIELDING—Are you all of the same opinion? I think it is a matter upon which experts may be divided.

MR. POOLE—Stone posts had been established in the coal fields years before, and the legislature had confirmed them as the correct corners, so that we have had no occasion to look into the matter.

MR. HARDMAN—I might say further, that this amendment did not affect the old areas, it was only to apply to new ground laid out subsequently to the passing of the Act. It was only in regard to new areas, they were to be laid out by the true meridian. I simply mention it as an example where legislation was passed which was not representative of the opinion of gentlemen connected with mining work.

MR. FIELDING—I remember hearing the discussion at the time the Governor-in-Council gave a hearing. (To Mr. Hardman)—At what stage of the bill did you offer your objections?

MR. HARDMAN—I went up to the House on the afternoon of the day I saw the amendment in the newspapers, and asked for Mr. Drysdale. He informed me it was too late to object, that the bill was passed.

MR. POOLE—We think most of these amendments to the mining laws would be better if more time was given to their discussion.

MR. FIELDING—Suppose a session is approaching the end, the Commissioner may have his attention directed to something erroneous, then he would try and remedy it. At the end of last session we had many things to do which should have been done earlier in the session. When the Commissioner believes a mistake has been made he rushes in to make an amendment. Every member of the House has his undoubted right to bring forward any legislation with respect to mines, but to say that no legislation should be introduced without supervision as you suggest, is going too far. An opportunity should be afforded the Mining Society and gentlemen interested in mining to present their views, and to represent what is most desirable, but the government cannot make it a positive and unbending rule.

The deputation having thanked the premier for his courteous hearing then retired.

Afternoon Session.

The members assembled at two o'clock, the President in the chair.

The first paper for consideration was:

Effect of a Lightning Discharge at the Scott Pit.

By CHARLES FERGIE, M.E., WESTVILLE, N.S.

The Scott pit shaft is 226 feet deep and down to the second seam, which is 12 feet thick, some eight feet being worked. For some months past the only work done on this seam has been the driving of a pair of slopes to the deep to intersect the main seam by way of a tunnel already driven. These slopes are 2,000 feet down, and the driving of them was proceeded with until about the end of July last, when, in consequence of the colliery supply of water for steam purposes showing signs of giving out, they were stopped, and all work confined to the main slopes, the Scott pit being laid idle. Previous to this the mine had been ventilated by a Schiele fan but having no steam to spare, in consequence of the scarcity of water, the fan was stopped and the mine received its supply of air by natural ventilation only. The seam being a very gassy one this mode of ventilation would not be sufficient to keep the mine clear, but as no person was to enter the mine until the normal state of affairs was again restored, it was not anticipated that any danger from an explosion of gas could possibly occur. The air of the mine being highly charged with fire damp, the necessary means of ignition were soon to be forthcoming. On the afternoon of the 8th of August, about 4.50, there was an electric storm passing over the vicinity of the colliery, and which discharged itself. The general office was struck by lightning and the front part of the building demolished. At the same time it struck the iron pulleys of the head-frame at the Scott pit and travelled down the steel winding rope entering the mine, and instantly igniting the gas accumulated therein which caused a

severe explosion, the force of which demolished the buildings on the surface at the upcast, and at another shallow shaft called the "stair pit." The writer, who was sitting writing by his office window, could not distinguish any lapse of time between the thunder clap and the explosion of the mine, so simultaneous were they. It being the opinion after the explosion that fire existed below, it was decided without delay, seeing that the ventilating shaft and fan were damaged, also the cages of the winding shaft, to seal up the mine, and this was done without mishap within about an hour and a half. The mine has since remained sealed and will likely be reopened about the end of October when the busy shipping season is over. The writer will then be in a better position to state the actual effects of the explosion underground and proposes to supplement this paper at a later date. Though having read of lightning having entered a mine by way of steel ropes, etc., the writer is not aware of any explosion having been directly traced to that cause before the one now referred to. This accident, and which was happily unattended by loss of life, clearly demonstrates that no mine where gas is allowed to accumulate to an explosive point can be considered safe from an explosion when it is connected with the surface by some conductors of electricity such as wire ropes, water pipes, steal rails, etc. It also serves to point out that where bore holes are put down from the surface for the purpose of rope haulage underground these holes and ropes should not pass through a return airway or where gas is likely at any time to be mixed with the air in high percentages.

Discussion.

MR. POOLE—That lightning can damage a pit has been spoken of, after the more conclusive case could be had, and the electric fluid finding its way into the recesses of a mine and causing an explosion of inflamable gas, has been on several occasions discussed, but I do not remember having read of any case that so conclusively proved that lightning had actually fired gases in a pit than the present one. No other alternative was possible, no one was below, no one was about the mine at the time, and simultaneously with the explosion, there was a violent electric discharge which injured the gable of a building some 200 feet distant. The earth tremor from the explosion was felt at Stellarton and caused those who noticed it to remark that they never before noticed thunder to shake the ground as did this particular report.

On several occasions lightening has been seen to run along the iron rails underground and in some cases men have complained of being partially stunned. Mr. G. I. Burns in Vol III, Part 4 of the Trans. Fed. Instit. M. E., 1892, mentions several cases where lightning was seen to enter coal mines in New Zealand and a premature blast in the Hoosac tunnel which killed some sixteen men was imputed to lightning entering the tunnel by the battery wires.

The question came up before the Accidents in Mines Commission in 1880, and in answer to an enquiry from the Secretary of State Messrs. Abel and Clifton wrote:

"The electrical excitement consequent upon the heavy storm which occurred at the time of the explosion as Risca would have had no effect 'in making gases more explosive' in other words the explosive properties of mixtures of fire damp and air are not influenced by violent electrical excitement.

"Electrical means of signalling may be used in localities filled with explosive mixtures of gasses with perfect safety, provided the battery employed will not produce a spark under any circumstances likely to occur in the working of the signals.

"There is no difficulty in obtaining batteries which are perfectly safe.

"We think it right to point out that it appears to us not impossible, considering the arrangements frequently existing in respect to metal guides, and to the wires used in the ordinary means of signalling, that during a violent storm a portion of an electrical discharge may find its way into workings and fulfil conditions necessary for the ignition of gas even at some distance from the pit's mouth."

MR. FERGIE—There is no doubt but that the explosion occurred through the lightning striking the winding rope and entering the mine. Simultaneous with the striking of the head-frame it struck the building. The conditions underground were favorable for an explosion—the slopes were full of gas.

MR. BAIRD—I thought I had an instance of the same kind in my mind, but I cannot recall it just now.

MR. FERGIE—You may not have the same conditions for an explosion in the mine during the next 500 years—that is for the lightning to strike that spot and have the air in the same condition—the air was at an explosive point.

MR. CLARKE—How would this effect the working of mines with electrical machinery?

MR. FERGIE—Where you have your ventilation up to an explosive point electrical machinery would affect; otherwise not.

MR. HARDMAN—At what point would the lightning probably leave the cable?—*i.e.* where was the flash underground?

MR. FERGIE—The cage was hanging at the end of the cable about 25 or 30 feet from the bottom and the discharge occurred at this point. It would be impure air right up to the cage from the bottom. It would be stagnant for about eight days.

MR. HARDMAN—So the flash would be at the bottom?

MR. FERGIE—Yes.

DR. GILPIN—There was a case on the continent where an explosion occurred which was attributed to lightning. There is a case where lightning entered a pit and traversed the workings but did not do any damage. It was about twelve years ago.

A vote of thanks, moved by Mr. Hardman, seconded by Mr. Clarke, was accorded to Mr. Fergie for his valuable paper, and was passed unanimously.

Notes on Practical Mining, Applicable to some Gold Mining Districts in Nova Scotia.

By MR W. R. THOMAS, M.E., Montague, N.S.

In treating this subject I propose to evade the much discussed and debatable question, as to formation of the "belts" with the contained auriferous quartz "leads," as found in Nova Scotia; leaving the solving of this problem to far more able geologists than myself, as well as to men who have had far greater experience in gold mining generally.

I intend asking you to consider a few principles, which may be applied in conducting mining operations in some gold mining districts of Nova Scotia, practically taking my stand on experience in the Montague district, together with information gained from conversation with people engaged in other districts in the province.

I also desire you to look on the following as being the conclusions of one who has had but a comparatively short experience, not only in gold mining, but in gold mining in Nova Scotia. However, I must candidly state that I cannot concur with the opinion of some mining experts, when they speak of the absurdity of men, who have only previously had experience in mining for other ores or metals, entering the profession of gold mining. I look on common sense and judgment as being the first and foremost principles which men in all the various branches comprising the mining profession should possess, and if possible, cultivate.

SURFACE OPERATIONS—In this, as well as in many other countries, some huge blunders have been made, not only in the erection of suitable machinery, but in the extent of the plant required. I venture to say that had the amount of money which has been unadvisedly expended in erecting extensive mining plants, been spent in mine development, the list of successful Nova Scotian mines would be much larger than at present. It is highly essential to have a sufficient quantity of machinery, enabling one to easily deal with the present output, but to commence the erection, on the laying out of a plant which the present developments do not warrant, looking a long way ahead in the dim future, is most certainly monstrous in its absurdity, and, in fact, a suicidal policy.

If a five stamp mill is of sufficient power to mill all the available quartz, why erect a 10 or 15 stamp mill? Or if a 30 h.p. engine is equal to working your pumping and hoisting machinery, is it economy to erect an engine of 50 or 100 h.p.?

Naturally, when water power is within reasonable reach, it is wise to utilize it, assuming that after full consideration from a business point of view, the profit derived will be sufficient to warrant the necessary outlay.

Where this much coveted power is not within reach, procure the strongest, cheapest and most economical style of machinery, of sufficient power to cope with your present requirements, remembering that the less machinery you have the correspondingly less will be your account for supervision, fuel, rates and taxes, &c., &c.

One of, perhaps, my strongest reasons for conservatism on this point is, that it is especially discrete where actual mining is so expensive—surrounding rock hard, and "leads" small—to reduce the surface expenditure to a minimum. Of course this policy should be practised in all cases.

It is not possible to develop a mine in a day, week, month or even a year, as mining operations are not carried on as rapid, as one might bring himself to conceive when using the parallel ruler, scale and pencil. To "mine" in the rock and to "mine" on paper are slightly different in their natures; the result in many cases not comparing as favorably as one might desire, one with another.

I have not had any experience in importation of machinery in this province, but am of the opinion that the government of this country would, by the abolition of importation duties, create a confidence between themselves and foreign investors which, in the future, they might not regret. I say this not thinking disparagingly of the class of mining machinery locally manufactured; in fact I have pleasure at having an opportunity to state that, in my opinion, the machinery manufactured in this country is of a first class order, and difficult to surpass; and I also feel assured that the local manufacturers are not afraid of competition.

LOCATING OF PLANT—It is also highly important in the laying out of a mine, that is the commencement of the necessary surface erections, to localise your plant as much as possible with a view to practising economy in the amount of labor employed in the supervision, &c.

In many countries, including Nova Scotia, economy in labor is an important matter, which should not be overlooked. I am personally acquainted with many instances where vast sums of money have been expended in the erection of mining machinery before even the most important considerations have been thought of. For instance, air compressing machinery on the top of a mountain, rendering the item, carriage of fuel, excessive; all of which might be saved by the purchase of 1,500 or 2,000 ft. of air pipes.

UNDERGROUND OPERATIONS—We have all heard discussions as to the advisability of vertical shafts in preference to the inclined shaft sunk on the dip of the "lead." The former appear to me to be sure investments when large quantities of rock are being handled, but where, as in many districts in this province, the surrounding country rock is exceedingly hard and where practically small quantities of rock are being handled, I believe that the inclined shaft sunk on the dip of the vein, proving the portion of "lead" sunk through is the more advisable.

The consideration is whether the amount saved in hoisting by application of cages against skips, is sufficient to warrant the outlay necessary to sink a vertical shaft, which has, undoubtedly, to be classed as dead work.

When several "leads" are known to exist in close proximity, where the intention is to cross-cut and develop them all from one centre, and especially where these "leads" are practically uniform in quality, it would probably be advisable to sink a vertical shaft.

The more important consideration, that is the prospect of deep mining, will be dealt with at the conclusion of this paper, under pay streaks, their persistency in depth.

I believe that everyone will agree with me when I say that systematic mining—the developments carried on by means of drifts about 100 ft. apart which are connected by winzes—is far ahead of the method—sinking several shafts and carrying on underhand stoping at the same time—which has been applied in many cases in this province. Assuming that the former system be adopted, the next consideration is what method of stoping should be applied. This, I take it, is a matter in which the mine manager has to exercise his discretion and judgment.

I have seen some portions of ground in the Montague district where, in my opinion, by applying overhand stoping, one is likely to not only lose a portion of the quartz among the debris deposited on the scaffold, but lays himself open, in all probability, to losing the gold, especially heavy gold.

This most coveted metal is undoubtedly highly attractive in its appearance and one gets so entranced by its sight, that he momentarily forgets who is the rightful owner.

Large quantities of rock can be handled more cheaply by the application of the overhand system, as shoots can be reared up with the stope, the intervening spaces being filled with debris.

I am a great believer in the application of the contract system in carrying on the developments of the mine. By doing so you employ the miner's brains, in addition to his manual labor. What interest can one expect the day's pay man will take in his work or in its result? Manipulation of labor is a very important factor in mine management.

A great deal more attention might be paid to cross-cutting, particularly at depths where the pay streaks are known to be continuous in richness. The application of rock drilling machinery is essential for this work, as well as for the general development of a mine.

PAY STREAKS—THEIR PERSISTENCY IN DEPTH—I look on this as being really the most important of all considerations relative to the future success of gold mining as an industry in this province.

When one looks around at the many gold districts and sees a large number of mines that were once successful closed down, the first question that presents itself is: What is the reason why operations have been suspended? The usual local reply generally consisting of: Could not cope with the water, reckless management; had a barren streak for a few feet, and just before closing down, rich quartz was discovered right at the bottom of the deepest shaft; never should have stopped, &c.

It is, in fact, nearly impossible, according to local opinion, to find a mine that has been really closed down through barrenness. In nearly every country one hears the same, what should be termed sentiment.

The next question, at what depth was the mine when operations were suspended, together with the reply, is something that requires consideration.

I have found when making this enquiry, that the approximate depth of abandoned Nova Scotian mines is from 200 to 350 ft.

When one gets this information he naturally concludes this must surely be the depth where the pay streak discovered at the surface ceases to be continuous in richness. There is one argument which may be fairly raised against this conclusion, that is on account of the former primitive system of mining applied. The cost of pumping, hoisting, &c., was excessive, and as depth was attained the general working cost proportionately increased, until the streak which paid from the point discovered to its present depth would no longer pay to work.

At present I am inclined to support the former conclusion, that is that the pay streaks become practically barren at a comparatively shallow depth—from 200 to 400 feet, but hope that this paper will be the means of creating a discussion which will enable the Society's members engaged in gold mining, to place on record their views, together with experience on this all-important subject.

As the extent of the mining machinery required for the working of our mines, depends very largely on this consideration, it is essential to know as far as possible the facts of the case, therefore we, as a mining society, having the interest of the mining industry at heart, should openly discuss a matter of this kind, seeking to aid the industry by placing it on a sound and creditable basis.

The inference drawn at first sight appears to be decidedly derogatory to the gold mining industry.

Seeing that there are an innumerable quantity of unexplored quartz "leads," running parallel to those on which good pay streaks have been found, I am of the opinion that it would be more advisable to ask investors to place their capital for the exploiting of these "leads," rather than to work abandoned "leads" possessing a good record.

Some people may argue that in every probability there are other pay streaks which occur below those already worked, and if the mines were developed to a depth of, say 600 to 800 feet, these streaks should be discovered. Assuming this to be a feasible theory, it would be a very difficult matter to secure capital with simply this object in view, as the development of Nova Scotian mines below 300 feet, through a hard dense quartzite, is an expensive business.

If the government of the country takes any inetrest in their gold mining industry, and if those in charge of the Department of Mines, by making the necessary inquiries, and gathering together the requisite information, arrive at the conclusion that the prospects of deep mining are favorable, would it not be putting it in a practical form, if they—the government—were to offer a bonus as an encouragement or rather inducement, to any investors attempting this form of speculation?

I am informed that the governments of Queensland and Victoria, on two or more occasions, voted sums of £1,000 and upwards, to promote the principle of deep mining together with other branches of industry closely allied to the same.

While on the subject, I would like to take this opportunity of calling attention to the mines inspection, as conducted by the representatives of the Department of Mines.

I have been engaged in mining in this province for nearly a year, and have never been officially called on, by either the inspector or deputy inspector, although, I believe, an inspection of the mine has recently been made by the deputy inspector.

I anxiously await the publication of Mines Report, 1893, when the work will probably be particularized in the deputies' annual report.

Candidly, what good does the publication of small matters of this kind do? In fact, it surely assists in keeping capital out of the country; for what speculator would for one moment think of the importance of gold mining in Nova Scotia after reading the extract from the official Mines Report (1892), as published in the *Critic* of April 14?

There is undoubtedly plenty of room for improvement in this direction. It appears to me that either the government or its officials might plead—"We have done those things which we ought not to have done, and we have left undone those things which we ought to have done."

I may state in conclusion, that many of the rich deposits of tin-oxide in Cornwall were discovered at a great depth, and that districts, where this mineral is found practically near the surface, are looked on as shallow districts, where the chances of deep mining are not as favorable as in the former districts.

I make this statement, with a view of calling attention to the many large quartz "leads," existing in the province, which on account of their not showing gold at their outcrop, have been apparently passed by as worthless.

Discussion.

MR. HARDMAN—This Society is much indebted to Mr. Thomas for his valuable paper. I want to endorse Mr. Thomas' conclusions in almost every respect, but at the present time I cannot agree with his conclusions in regard to pay streaks. It may be true, and it may not be true, and the following case may be the "exception proving the rule." Last week in Oldham on the Standard Company's property at a depth of 520 feet we got the top of our pay streak, I simply state the fact that on one lead, at any rate, the pay streak has been cut at 520 feet depth on the incline.

MR. POOLE—At about what angle of inclination?

MR. HARDMAN—At 43 degrees.

MR. POOLE—The Wellington was on an angle of that inclination, was it not?

MR. HARDMAN—The Wellington was sunk 300 feet on the incline of 45 degrees, then the pay chute was followed for 300 feet to the westward at a dip of 35 degrees. The length of the winding rope was 600 feet, but the depth on the incline was 500.

MR. WOODHOUSE—I would like to ask any gentleman present who has been looking up the theory of pay streaks and taking vertical depths, whether he has found gold 400 feet below the surface?

MR. POOLE—How deep is the Salmon River mine?

MR. STUART—300 feet.

MR. HARDMAN—Taking our 520 feet on the incline would make about 340 feet vertical.

MR. WOODHOUSE—I think Mr. Thomas can give us some pretty valuable advice on this point. He is down about 300 feet. One of the deepest points in Montague was on the Rose lead, worked by Mr. Lawson—at one place it is 345 feet and the other 380 feet.

MR. THOMAS—The Rose lead is 365 feet, and the other lead worked was cut off by a dislocation.

MR. WOODHOUSE—Was that 365 feet vertical?

MR. THOMAS—Pretty nearly vertical.

MR. HARDMAN—In this particular chute I have reference to it is as one continuous streak for nearly 1,700 feet in length, and will extend to probably 2,000 feet.

MR. THOMAS—We had a streak at Montague. I drove a level at 264 feet from the surface and found that throughout, the streak was fairly profitable for every 100 feet. With regard to the Lawson streaks—I think they were the result of intersections—so I would gather from the map and from information received from miners living in the district.

MR. HARDMAN—That lode would be similar to the streak found in Oldham in 1877 by T. N. Baker. It was made by intersections of angling veins with the main lode—the angle of dip of lode would be 60 degrees.

MR. THOMAS—What would be the law of streaks in the Windsor Junction property at Waverley?

MR. HARDMAN—I do not think there are any facts recorded to show any law. The shaft is nearly down to 400 feet on the Tudor lode. I have been told the inclination of the streak is 35 degrees to the east—but so far as our own workings went we failed to discover any streak whatever.

MR. HAYWARD—On the Lake View property—Dominion Lead—the streak extended from the surface and was cut off by a break at 360 feet on the incline.

MR. WOODHOUSE—I would like to know the reason why some of the mines have been closed down—I would mention the Rose for example, also the Lawson. I would like to know the reason for closing down these mines. Perhaps the pumps did not compete with the water—or perhaps they did not wish to make any more money.

MR. STUART—I think I know something about the Lawson. I was the last man who worked it. I had had just such favorable reports as that made to me—"It is as good at the bottom as any part of the old workings." Mr. Lawson told me the last was poor and had not paid for several months. But my object in pumping out the mine was to drive some cross-cuts in what I call the "side lead." I think that side lead had something to do with the richness of the Lawson mine, yet it did not make the streak entirely, nor was there any regular gold streak. The gold was more in pockets and not in line. They were at different parts of the whole workings, not continuous but distributed over the whole ground that was worked, but the quartz taken out between these workings was not barren. At 360 feet it was pinched to about two inches and only gave me two pennyweights to the ton, but in the western end where the lead was larger, it gave from 15 to 20 pennyweights, but the pay ground was short. The plan kept by Mr. Lawson showed conclusively that there was no regular pay streak. He crushed by contract for each crew of men separately each month, and indicated on his plan the exact amount of quartz taken out of each portion of the ground, and the exact amount of gold obtained.

MR. WOODHOUSE—A copy of that plan is in the Mines Office, is it not?

MR. STUART—I think it is.

MR. POOLE—I think it is published in the report of 1876.

MR. STUART—I quite agree with Mr. Thomas in regard to the various reports of the mines which shut down, and that it would be well to compel mine owners to keep a plan on file in the mines office when the mine is shut down; it would prevent a great deal of toil.

MR. CLARKE—Is there not a provison to that effect now?

MR. STUART—It occurs to me that there is something to that effect.

DR. GILPIN—That point has been talked of for some time and my idea was to have a man make it his business to go and get that information and put it on a plan, so that it would be placed on record.

MR. STUART—Would it be too much to have that attached to the inspector's duty?

DR. GILPIN—I am afraid it would. At first it would take a great deal of work to get the thing up; after that not so much.

MR. POOLE—Appoint another officer.

DR. GILPIN—There was an amendment put in the Act by James A. Fraser to that effect. To do that would simply mean another officer. Now that the royalty is getting better it has come up again.

MR. STUART—I think it would not be too much to make it obligatory on the mine owner.

MR. THOMAS—In the west of England all mine owners are bound to keep plans and data up to date, and when the inspector comes on his round he sees that the work is done.

Government Aid to Mining—A Suggestion?

MR. JOHN HARDMAN—The title of my remarks as printed by the secretary is "Government Aid to the Mining Industry—A Suggestion?" I was careful to have at the end "A Suggestion," and I beg that it be kept in mind, but from the interview of our committee with the Premier this morning, and from the discussion on Mr. Thomas's paper this afternoon, it is quite evident that the suggestion is an opportune one. As a government function we would have good precedents for the government's undertaking to give aid to the mining industry. I notice that Mr. Thomas in his paper speaks of the sum of £1000 being voted in Victoria. In the fiscal year of 1886 the government of New Zealand spent over $50,000 in water races, nearly $150,000 in roads, and over $180,000 in actual construction or subsidizing of other works and for the purposes of deep mining and of furthering the interests of mining generally. The total amount appropriated for gold fields alone in that year being nearly $400,000.

The Spanish government recently spent over $200,000 for a new building for a mining school in Lisbon, and in New South Wales they are spending large sums every year—£40,000 I believe. So that we have very good precedents when we go to the government of this country and ask them to help to forward the mining industry. I am now speaking particularly as a gold miner, but I do not see why the idea should not be equally servicable and valuable to other kinds of mining. At the outset the question arises if the government is to extend aid to mining, is it to the Provincial, or to the Dominion Government we should apply? I think it will be remembered by some here that in the year 1881 the Provincial and Dominion united in having surveys made of Lawrencetown and one or two other districts and they contemplated making surveys of more districts but the work was discontinued because it was found to be too expensive. It seems to me that we have no claim on the Dominion Government in this matter, as all the royalties are payable to the provincial treasury, and I do not see, therefore, any reason why the provincial government should not bear all the expenses. There have been some previous efforts in this line of asking government help; propositions were made as far back as 1887. Mr. Thomas suggests in his paper that the government should give a bonus. I think the original form in which government aid was asked was that the government should sink a test shaft in such a place as should be desirable in order that the existence of workable veins at great depths might be proved. But a difficulty arose at once; in which district should this shaft be sunk? Each district could put forward claims that would make a decision difficult, if not impossible, and this proved a fatal objection.

The next suggestion was that the first man who put his shaft down to 1,000 feet should receive a bonus of $10,000 or like sum. But there were certain valid objections raised to this proposition. A shaft sunk in Montague might not tell us about the strata in Renfrew, or Wine Harbor, or any of the other districts. Again it was suggested by the late John Kelly that the government should remit the royalty on all gold coming from certain depths. Gold from below 500 feet to 1,000 feet should pay a royalty of only 1 per cent., and from below 1,000 feet should be free of royalty, in other words the amount involved was a bagatelle and not worth considering.

And more recently still the suggestion has been made that the government should purchase a diamond drill, and bore from 3 to 4 holes in each district to test the existence or otherwise of workable veins. All of you here know that a bore hole might go down within 12 or 13 feet of a pay streak and yet the core show poor ground, the drill again may go through a pinched portion and fail to indicate any quartz lode at all.

In spite of the failure of these several schemes to materialize, yet it is highly desirable that the government should extend such aid and help to the gold industry as would tend to advance the output and increase the knowledge we now possess of the resources of the industry. Therefore, I venture to bring forward at this time an idea which has been gradually taking shape with me, and which I believe would be of permanent value and material benefit to the whole metallic mining interests of the province, and especially to gold mines.

I suggest the construction of detailed topographical maps of each prominent district, accompanied by a monograph in pamphlet form, which shall explain the map and give fuller letter-press descriptions than the scale of the map may allow.

The details yet remain to be worked out, but the salient points I may describe as follows:—

The map, constructed on a scale of *not less* than 200 feet to the inch, and preferably 100 feet to the inch would show—first, the area lines, distinctly and clearly indicated by a faint green line, the area numbers being also printed in the same color; secondly, the roads, in a brown shade; thirdly, all known and located lines of faults or breaks by a conventional dotted or broken black line; fourthly, the out-crops, or worked portions of the out-crops, of all discovered veins by red lines; fifthly, all streams, swamps and wet ground in blue lines, tints or hatching; sixthly, showing contour lines, either 10 or 20 feet apart, over the district, in continuous faint black lines.

In addition, the location of each shaft or incline, over 20 feet in depth, should be noted and the position of buildings of a permanent nature, as mills and steam hoists, etc., should be marked.

By a system of letters, with corresponding references in the margin, a great deal of information could be placed in small compass, directly on the map sheet, which should, of course, be detachable from the pamphlet for convenience of reference.

To simplify matters and explain the scheme to you much more graphically than I can talk, I have prepared a map of a portion of the Oldham district, showing about 27 areas out of some 500. (It is to be regretted that owing to the time involved in the reproduction in colors of Mr. Hardman's map, we are not in a position to publish it in this issue.—Ed.) I may say here, that the intention is to confine the map closely to the limits within which gold bearing lodes have been found, and not to extend the map beyond the worked limits of any district. I regret that the time at my disposal has not permitted me to put the contour lines upon this sketch of Oldham district, but I am sure you will agree with me that they should be an essential part of the map.

The monograph accompanying each map could be made up largely from the provincial records, and the reports of the Dominion Geological Survey, supplemented by information obtained during the actual mapping of each district.

This monograph should contain, amongst other things, a full official record for each year of the amounts raised and milled and the yield therefrom; descriptions of the more important veins and their workings; the peculiarities, mineralogical and lithological, of the district; sections of the district at important points, and simple line drawings of the underground workings of the chief producing lodes. Also such other available information, technical, economic and geological, as would help to make a complete history of each district to date.

Doubtless one of the first qustions I shall be asked is: "What will it cost?" To this I am prepared to give an answer. I have consulted Mr. Faribault, of the Dominion Survey, on this matter, and have availed myself of his experience and advice. Primarily, there are but thirteen or fourteen districts which I would map as suggested; I would say that a district which has not produced a minimum of 5,000 ounces since discovery, was not important enough for this map. Starting therefore with 15 districts the cost of fieldwork, plotting, compiling, printing and lithographing, should not exceed $20,000. Some districts will cost more than others, for example: Sherbrooke and Waverley, the two largest and greatest producing districts, would probably cost $2,000 each. While Wine Harbor and Oldham would not cost over $1,000 each.

Much of the work could be done cheaply. A provincial land surveyor with assistant could go over the ground first, laying out area lines, marking each corner with small temporary stakes, and at each tenth stake putting in a more permanent monument; after him let two men come on with a level—engineering students from Dalhousie or McGill, who would be glad of the experience in the field—and run the contours. Finally let the chief, or geologist, come last with one good assistant; marking on the map as plotted by the two corps preceding him, the various veins, faults, etc., etc., as I have already mentioned, and collecting and arranging the large mass of valuable matter now solely recorded in the heads of the older local residents whose ranks time is steadily thinning.

From two to four, or an average of three, of these maps and monographs could be completed each year, putting on the Provincial Treasury a strain of not over $4,000 to $5,000 per year. After these maps are once published it is only a matter of local statutory regulation to have them kept up to date by the Mines Office.

I do not believe that there is a gold mining corporation or firm represented in this room but would have saved thousands of dollars in preliminary exploitation work had such maps as are proposed been available to him before he began work.

I may go further and say that I do not believe the Province of Nova Scotia can better advertise her resources abroad than by the dissemination of such maps and documents. It appears to me to be a case of killing two birds with one stone, advertising her mineral resources, and substantially helping the mining industry at the same time.

And I close by urging upon you the necessity of preserving in some form the data we now have in the memories of the older miners. Twenty years from now they will all be dead, and information gained will be dead, and information gained will be at second-hand.

DR. GILPIN—There is no doubt about it now is the time to do this thing. In respect to the remarks in Mr. Hardman's paper about the survey made by Mr. Dawson—the facts were that an agreement was reached between the Dominion Government and the Local Government in 1880 that they would join in bearing the expense of a topographical survey of the gold district starting from Halifax and extending eastward. This was projected in order to facilitate and expedite the work of the Geological Survey which was working from the east to the west on the Atlantic coast, so that whenever he struck the ground which had been previously surveyed he could get through his work more quickly. The amount of expense was considered too great and the survey stopped at the end of the first season. The plan of the work of Mr. Dawson became the property of the local government and has been in frequent demand and proved very useful for many purposes connected with surveys and location of waterworks, etc., and has undoubtedly saved expenditures in surveys, and paid for itself many times over.

A vote of thanks was unanimously accorded Mr. Hardman for his valuable remarks.

Members Dine Together.

Promptly at eight o'clock the members to the number of thirty filed into the St. Julian dining room and sat down to an excellent dinner served by the proprietors of the Halifax Hotel. Mr. H. S. Poole, President of the Society, occupied the chair. Among the other guests present were noticed the Hon. W. S. Fielding, Premier of Nova Scotia, and Mr. S. P. Franchot, Vice-President of the General Mining Association of the Province of Quebec. Ample justice having been done to the generous bill of fare, a number of toasts were given, the speakers of the evening being Premier Fielding, Mr. John F. Stairs, M.P., Mr. Arthur Drysdale, Mr. R. H. Brown, and Mr. S. P. Franchot. The proceedings were enlivened by a programme of songs and choruses to which Messrs. G. J. Partington, W. R. Thomas, Alfred Woodhouse, B. T. A. Bell and others contributed, Mr. Ernie Wylde officiating with much acceptance at the piano. Considerable diversion was caused by the droll and humorous selections most effectively delivered by Mr. Frederick Taylor, of Lowell, Mass. The fun was kept up until a late hour, indeed as far as we recollect "the wee small hours ayont the twal" were well advanced before the members dispersed, thoroughly pleased with their evening's enjoyment.

Excursion to the Montague and Waverley Gold Districts.

On Friday morning a number of the members drove out in a four-in-hand to the Montague and Waverley gold mines where an interesting time was spent at the properties of the Symon-Kay Syndicate, the Nova Scotia Gold Mines (Ltd.), and the West Waverley Gold Co. (Ltd.) An inspection was also made of the work being conducted in the Laidlaw's Hill tunnel at Waverley. In a future issue we hope to be able to make a more extended reference to the work and prospects of these districts, which lack of space, it is to be regretted, prevents in this issue. An excellent luncheon was served at Beech's Hotel. The members reached town shortly after dark, having, notwithstanding the wet weather which prevailed, greatly enjoyed the drive and the outing at the mines, and each and all returned with a keen appreciation of the many courtesies that had been extended to them, notably by Messrs. Hardman, Wilson, Thomas and Woodhouse. It is greatly to be regretted that on account of other engagements a large number of the members of the Quebec Association were unavoidably prevented from participating with their brethern in Nova Scotia in the pleasures and excursions of this meeting.

Ontario Mining Association—President Hammond's Address.

At the annual meeting of the Provincial Mining Association of Ontario, at Sault Ste. Marie, on 4th October, Mr. J. R. Hammond, of Sudbury, President of the Association, said:—

"I wish upon the occasion of our annual meeting to recall for a moment the work we have done in the interests of mining and the formation and direction of mining policy in this province since we organized in this town on the 7th of October, 1891, and to touch briefly on the work we may in future aid in accomplishing, as well as the means at our disposal for bringing this work to a successful issue.

It was due largely to the suddenly expressed intention, and as sudden action of the Ontario Government regarding its mining policy, without previously sounding the opinion of our citizens at the polls or otherwise, except the few days allowed between the rapidly succeeding readings of Bill that thereupon became law, that our infant mining industry suddenly found itself more tightly than ever wrapped in the swaddling cloths of what we then believed, and still have reason to believe, is an extremely tight-fitting and restrictive mining policy; in spite of the fact that a Royal Commission, appointed by this same Government, had but lately finished a comparatively exhaustive examination, not only of our mineral resources, but of ways and means, and had ended by unanimously advising liberality and urging that room be made for expansion. Failure to take the advice thus asked for, at vast expense, and the fact that exactly the opposite was made law, at a time when the industry showed some signs of revival after a long period of depression and inaction, rapidly bred sharp criticism and the desire for the creation of a society whose chief object would be the safeguarding of interests, than which none are more important to individual and national prosperity. How far this was done and what has since been accomplished, is already become matter of history, but I might be permitted to note as some of the more important events with which we have been so closely identified, the pressing of our just claims upon the attention of the Government and the electorate at large, by means of petitions and addresses, and the enlistment of the sympathy and co-operation of the press, with the positive result of causing the legislature to pause and recede from an untenable position, and the awakening of the people to the vital importance of the issue before us. To be factors in endeavoring to achieve such important results we have conceived to be our privilege as British subjects and as Canadians, and our duty and our presence and influence here to-day, gathered, as we are, from far and near, is the best proof we could have that there is work still to be accomplished in this cause.

But it is not enough that our interests are now united throughout all this vast Province; difficulties have still to be faced in the development of our mineral resources, resources which, as year by year goes by, are proving themselves as rich and varied as those of any country in the world, and we are met to devise ways and means for bringing their legitimate claims still more prominently to the attention not only of our own citizens, but of the world at large. Our field is the world, and to the world we must appeal. We must continue to show it what we have got and cultivate its acquaintance and assistance, and unite our efforts with those of competent and willing outsiders in building up a mighty mining industry. This has been done by other countries, and it can, and will, be done by us. As a well organized association we can but aid in this great work, and with all the assistance we can obtain, bring it to pass.

As to ways and means, though it might yet be said that we are a feeble folk, yet let no one despise the day of small things—great oaks do out of acorns grow,—and when we shall have ceased to quarrel and fight for place and power in petty party politics and shall have really and truly begun to study the lasting interests of a young and struggling country, we shall then truly recognize as individuals and as a country what we need to aid us in extracting a livelihood whence it is pre-eminently honorable to deprive it from mother earth. That the mining industry can lay claim to the best right to existence has never been or can be disputed, and I say it is a sorry spectacle to see unnecessary restrictions put upon manual labor and the willingness to labor on the part of either individual or government. Such restrictions we charge to-day upon a government which is responsible for the best utilization of not only our mineral, but I may also add incidentally our agricultural and other resources in a manner that leaves honest labor freedom to work out its salvation. Time and again, as also during the present year, have we appealed for aid, or mere recognition in our feeble endeavors, only to be turned away with promises unfulfilled and amounting to nothing, or told that it would not do. We care most for this country which we claim as our birthright, and upon which we are at liberty to expend our labor and reap the fruits thereof, and not for any political party chiefly eager to wield a power we should yield only on an honourable and definite understanding and agreement that ours will be fulfilled, and not upon an unseemly and hasty party struggle in outdoing their opponents for that power and its consequent emoluments at the expense of this country. But this not only desirable but necessary condition in all economic and honest government can only be fully obtained by thorough organization and presistence of endeavor on our part.

It is believed, and some would know, that we are on the eve of a provincial election, and that the usual squabble for votes will ensue. Gentlemen, vote for no man who is not in sympathy, heart and hand, with the temporal welfare of his country, and especially of his immediate neighborhood, or who will not, on the day of testing, in or out of legislature or parliament, stand out irrespective of mere party politics or personal interest for the crying needs of the daily toiler in our mines or elsewhere. Honor to our ex-president, James Conmee, for the stand he took in the late sessions of our provincial legislature, and honor to faithful workers everywhere in the interests of the development of our young country. The day will come when the territory now embraced in this District of Algoma, will teem with millions of happy and prosperous people, nor is the time so distant as some would have us think. Germany is about twice as large as such a tract, and possesses no great natural resources, while supporting upwards of forty-five millions, besides having thousands of sons to spare each year.

Prominent in Algoma for all time to come, will be her stores of mineral, vast beyond conception. Her iron, her nickel, her copper, her gold and her silver will, under a liberal and enlightened mining policy yet be found, not only supplying her own growing wants, but also those of every land, in return for the treasures of other climes We stand to-day upon the silent hills, as prospectors, as pioneers, in a vast country, and can, it would seem, but little more than speak and think of a time when the chimney tops in the valleys and the hum of industry in our mines shall speak the more precise language of labor, of prosperity and peace. But as regards the duty lying next to hand, it is ours not to fail of its performance, and to strengthen the faith of our fellow-countrymen in themselves and in the land of their birth or adoption."

The Ophir Gold Mine.*

By W. R. Wallace, Bruce Mines, Ont.

The Ophir Mine has within the year just closing been prospected in the following manner:—One vertical shaft 95 feet deep to cut the incline or dip of the vein, which was reached at 90 feet when rich ore in vein of 12 feet in width was cut. One incline shaft to connect with this shaft was sunk 105 feet. Along the foot-wall of the vein which dips 45 degrees south, this entire incline was in rich ore and the values more as depth was reached; only one wall was exposed in the incline. The hanging wall was not reached. The cut is 7 by 8 feet all in good ore; above this and along the outcrop of the vein I have made four tunnels, the length of each as follows:—The first, or No. 1, is cut 50 feet; the second, which is 25 feet above this, is 80 feet in length with an uprise from the first for ore chuttles from dumps above; No. 3 is now 53 feet in length, and No. 4 85 feet, making 205 feet of upright cutting and 268 feet of drifting. In the drifts I have done no work, except on the pay streak, and this at the lower boils of the drift is 23 feet wide and narrows towards the surface to about 16 feet. The vein is thus exposed 578 feet in length and 230 in depth. I estimate 7,000 tons of ore on the dumps and 200,000 in sight on the pay streak alone, with twice that in ore that will mill $10 and $12 per ton. The mill runs made by Prof. Sharpless, of the Michigan Mining School, on 5 tons of ore from the pay streak, which I made as fair an average as possible, returned $46 per ton in free gold without the concentrates, which can be estimated to contain as much more value.

Our mill is now nearly completed, and by the first week in October we expect to commence milling in earnest, and hope to be able to run regardless of cost through the winter without interruption.

The mill has been carefully designed (with the latest patents for saving refractory ores), and I think it is one of the most complete plants in America, and as good as the best. I shall be pleased to report the results of its workings to your honourable body at any future meeting.

*Paper read before recent meeting of the Ontario Mining Association at Sault Ste. Marie.

MINING NOTES.

[From our own Correspondents.]

Nova Scotia.

Caribou.

The property formerly owned by the Lake Lode Company, now owned by Messrs. Gue, Wilson and others, is being reopened by Mr. W. A. Saunders under agreement. The water has been taken out to a depth of nearly 200 feet, and the shaft re-timbered and made secure. The lode will be opened laterally at different depths and tests taken therefrom. The property formerly was remunerative, and that under very bad management.

Brookfield.

Mr. John McGuire, formerly connected with the Molega Mining Co., is doing some work at the North Brookfield mine, preparatory to testing some new leaching process for extracting gold. The quartz from this mine has the reputation of carrying gold too fine to be saved by stamp mill amalgamation. The details and chemistry of the leaching process will not be made public until after the test.

Moose River.

It is rumored that Mr. Stephens and others will commence work on a block of unprospected areas in the 1st of October. The same rumor says rich float has been found.

Oldham.

The Standard property, owned by Taylor and Hardman, is keeping up its record. Several tons raised and milled in August yielded at the rate of 100 ozs. per ton. The output from this district for 1893 is expected to exceed all previous outputs.

The Columbia Company are still developing their property; a cross-cut being carried to the north to cut known lodes and a level is being driven to the westward on the Wallace lode at a depth of 100 feet.

Renfrew.

Mr. D. A. McDonald is reported to be getting average ore in the New Haven property. No quartz has yet been milled. The syndicate operating is composed of Pictou men.

Mooseland.

The reports from the Mooseland Company's property are good, the quartz gaining in value, and the lode holding its size.

Waverley.

The West Waverley Co. are running twenty stamps double shift, and report yields to be of average value for that mine, viz., 4 to 5 dwts.

The Tunnel Co. are working one shift, and report quartz showing well.

Quebec.

Lievres River.

Mr. J. Burley Smith, M.E., is conducting a series of tests with a Bullock Diamond Drill on the Ætna and Squaw Hill mining property of the British Phosphate Co. at Glen Almond. We understand that these have proved most satisfactory, locating deposits of phosphates which will pay to uncover. A contract to drive into one o these large bunches has been given and work is proceeding.

About 45 men are employed at the High Rock phosphate mine where the pits still look well. The deposits in pit No. 3, which a few weeks ago looked poorly, have come in again and show extremely well. A considerable quantity of low grade material continues to be ground at Basin du Lievres mill, whence it is shipped to the fertilizer works at Chicago.

Ontario.

The Ophir Gold Mining Co., Limited, operating in the township of Galbraith, about sixteen miles from the village of Bruce Mines, has its 20 stamps dropping and about 45 tons of rock are being put through the mill daily, but inasmuch as the retort and melting furnace are not yet complete, no clean-up has taken place. Much interest will be taken in the returns. The new mill building contains four storeys. The stamps have a weight of 850 lbs. and drop about 80 to the minute, being driven by a Corliss engine supplied by the Doty Engine Co., of Toronto. Eight fire vanners are used for concentration. About 600 tons of quartz have been raised this year and will be put through the mill as speedily as possible. A later mine test (to those given in REVIEW some months ago) has been made by the Michigan Mining School of 1,125 lbs. of ore sent from the mine, with the following result: Silver, 1·80 oz. per ton; gold, 3·50 oz. per ton. About 30 men are employed under Supt. W. R. Wallace.

British Columbia.

Kaslo District.

Construction work is still being pushed by the C.P.R. between Nakusp and Slocan Lake, and a rumor is current that the owners of New Denver have given the railway 1,000 lots in that town, although as yet the rumor has not been certified.

Representatives of the Kaslo and Slocan Railway and of the Great Northern Railway are to meet in Spokane to-morrow, the 19th inst., with a view to the charter now held by the former company being sold to the G.N.R.

Since the 14th of August last there has been shipped 1,378,000 lbs. of ore from the Slocan mines, over 900,000 tons being shipped via the C.P.R., and the balance by way of Bonner's Ferry and the U. S. Returns, on the whole, show a higher grade of ore than previous shipments.

Considerable dissatisfaction is felt by some of the shippers owing to the way they have been treated both by the U. S. smelters and the railway company. They claiming a too great shortage in weight and an overcharge in previously agreed upon freight rates, besides considerable trouble with the customs. In consequence of this some of the shippers intend sending their next lot of ore to Swansea, Eng.

In the Noble 5 mine a wonderful rich strike has lately been made, the ore referred to being a tetrahidrite together with much soft decomposed matter, assays of which show that it will run over 1,000 ozs. to the ton, and the body is said to be unusually large for such high grade ore. The strike was made in the first discovered vein of galena.

Ore is being hauled to town daily but the road is reported in bad shape from the wet weather that has already set in and the loads are consequently light. Indeed little can be done with waggons in this country, but we have several months of first-class sleighing.

Prospectors have all been forced out of the mountains for this year by snow.

The Josephine Mining Company (Foreign), was registered at Victoria on the 9th instant. The company's authorized capital is $600,000, divided into 600,000 shares. Nelson is designated as the domicile of the company. Its promoters' names are not mentioned, neither is the location of its mines. The East Kootenay Exploration Syndicate, Limited (Foreign), was registered on the 5th instant. This is the company that acquired the Griffith-Galbraith hydraulic claims, on which quite an extensive plant has been placed, including electric light, so as to prosecute work by night as well as by day.

The government has decided that copies of all records of mineral and mining claims in West Kootenay shall hereafter be kept at Victoria, and with that object in view has sent Charles Hayward, Jr., up from Victoria to do the clerical work. Mr. Hayward left Nelson for New Denver this morning to make copies of the records at New Denver. Now, if the government will only have some competent clerk make copies of all records at Victoria relating to land in West Kootenay, and forward the same to Nelson, then create a registry district with the registry office at some central point, the people here would be accommodated, as will be the people of Victoria when copies of our mining records are kept for reference in that city.

A 40-ton shipment of ore has been made from the LeRoi mine in Trail Creek district to the Tacoma smelter. Work has been resumed on the War Eagle mine, in the same district, with "Joe" Morris as superintendent.

Two of the claims in the Grady group on Four Mile creek, Slocan district (the Alpha and Black Bear), have been bonded. The bond is for $70,000. A cash payment of $5,000 has been made, the balance to be paid in three, six, nine and twelve months. N. F. McNaught secured the bond for outside capitalists. Mr. Briggs, one of the three owners, was in Nelson to-day.

The Hall Mines, Limited, magnates have come and gone, and actual work has once more been resumed on what is likely to be one of the greatest mines in the world. The survey made for the tramway shows that the distance from the Silver King to the water front, a mile below Nelson, is little more than 4½ miles. The tramway will not be built until spring, as the plans must first receive the approval of the board of directors—and the board meets in London. Between 300 and 400 feet of shafts, crosscut tunnels, and drifts, will be run during the winter, which will give employment to forty-odd men. Additions will also be made to the quarters of the men and a shaft-house erected.

A shaft will be sunk on the Kootenay Bonanza; a drift run both ways from the winze sunk in the main tunnel; and a drift run both ways from the old shaft on the Silver King. These drifts will be started about halfway down on both the shaft and the winze. Most of this work will be done by contract.

Preparations are being made to ship a hundred tons of the ore now in the ore-house to Swansea, Wales; and if navigation holds out on the Columbia river, further shipments will be made. All the ore take out this winter will be carefully sorted for shipment, which indicates that, for a time at least, the high-grade ore will be shipped to Wales.

(From the Miner.)

The Perry creek placers will be worked next season on a more extensive scale than ever before. A syndicate of English capital is said to have been formed for the purpose of giving the ground a thorough test. A great many thousands of dollars will be spent in wages and materials, and the people of that section consider the outlook to be more favorable than ever before.

Referring to the Silver King (Hall Mines, Ltd.), the *Miner* says: J. C. Yuill, and A. Findlay, have the contract for the tunnel on the big croppings. The temporary shaft on the Kootenay Bonanza is in the hands of Spencer and Bates. Cody and Landrigan have secured part of the drifting, and the remainder of it will be done by Mr. Conners. Robt. Yuill, the old foreman so long connected with the property will retain his position during the winter.

The tramway will not be constructed till spring, but Contractor Nelson of the N. & F. S., has decided to figure on the work, and will probably winter in Nelson, provided he got an ore contract to fill in the interval.

Among the moves contemplated for the immediate future is the making up of a trial shipment of ore. A big shipment of the best ore, carefully sorted, will be sent to Swansea, for experimental treatment. Upon the returns received from this shipment, will depend to a great measure, the construction of a matteing plant.

The Wild Horse creek district placers are said to have placed $27,000 to their credit as the gold dust production for the month past. A new town has been laid out on this creek at a point about three miles from Ft. Steele.

Miscellaneous.

At the recent meeting of the the newly organized Miners and Mine Laborers' Protective Association held at Nanaimo, the following officers were elected: President, A. Wilson; vice-president, R. Smith; Secretary, F. Wagstaff; financial secretary, J. Week; treasurer, W. S. Keith.

The Kootenay Hydraulic company took out seventy-two ounces of gold, which represents fifteen days' piping.

Deliveries of coal into San Francisco from British Columbia Collieries, for the month of September, amounted to 51,600 tons, or 50 per cent. of the coal received at that port during the month.

Respecting the discovery of a new gold field of great promise in the Alberni district, the *Colonist* has the following:

"Alberni will, according to present indications, be the centre of attraction next spring for gold seekers in this province. Reports from the few prospectors who have gone in there since the recent discoveries of rich quartz vary only in the details, for all agree that what has been found is good pay ore, and that the indications are that the veins extend over a much larger tract of country than is generally supposed. G. E. Jorgensen, the well known surveyor of this city, who has recently returned after two weeks spent in the Alberni district, is quite as enthusiastic as those who have already been heard from on the subject, and he has shown his faith—which is based on previous observations of gold quarts in other places—by associating with other gentlemen in the location of a promising claim which is to be worked in the spring.

"I spent two weeks up there," he said to the *Colonist* yesterday, "and the more I saw the better I liked it. There is no doubt that the veins are rich, and so far as has yet been ascertained they are continuously so. Certainly they extend over a large tract of country. My belief is that they can be found almost from one coast to the other on the island, and running as they do, northeast and south-west, they head straight for the gold country in Cariboo.

"It is surprising," he continued, "how skeptical the public have shown themselves about this matter, and I have heard people profess disbelief, for the most fanciful reasons or for no reasons at all, of reports which I know to have been absolutely reliable. Of course no actual working results have yet been obtained, because there has not been time, but next season there will assuredly be several mines in active operation. Ours will, for one. I have heard that English capitalists have secured an option on one of the most promising properties, and it is their intention, if they conclude the bargain, to lose no time in getting to work.

"Until recently no one gave a thought to quartz mining in this country, placer working being all the rage, and thus it happened that these rich deposits which crop-

ped out and were talked of in several localities received no further attention. I was told of one discovery made a long distance from the scene of present operations, by gentlemen from the neighborhood of Duncan's, who, after locating a claim, allowed their title to lapse, simply because everybody, knowing nothing about the value of the ore, said that there would be no money in quartz mining. These gentlemen have recently come to a different conclusion, and will again stake their claim, which, fortunately for them, has not been taken up.

"The country is a difficult one to prospect in, but once a vein is struck it can be followed without difficulty, and the general situation is such that tramways can be constructed without abnormal expense, to take the ore down to the sea coast for transhipment to the smelters. The proximity to the coast is one great advantage that this country has."

CANADIAN COMPANIES.

Bootanie Creek Gold Mining Co.—Applicant for charter under British Columbia Companies' Act. Capital $150,000, in shares of $100 each. Head office: Vancouver, B.C. Trustees: Walter H. Kendall and Samuel Knox Twigge, Vancouver, and Duncan H. MacPherson, High River, Alberta, N.W.T. The new company is being formed to acquire and work mineral claims at or near Bootanie Creek B.C.

Hamilton Iron & Steel Co. Ltd.—Applicant for charter under Ontario Statutes. Capital, $1,000,000, in shares of $100. Head office: Hamilton, Ont. Directors: J. Jennings Moorehouse, New York; Wm. Van Veghten Reynolds, Reynoldsville; Wm. Foster, Jr., New York; Ed. Harris Thompson, Millerton; Herbert Nelson Curtis, New York; J. Henry Tilden, Hamilton; John Milne, Hamilton, and Robert Jaffray, Toronto. Formed to mine lands and operate mines in the Province of Ontario. Operations are in the County of Wentworth.

East Kootenay Exploration Syndicate was registered under the Foreign Companies' Act, (B.C.) at Victoria, on 5th October. Capital, £80,000, in shares of £1 each. The places of business of the Syndicate in Canada, is at their mines, Wild Horse Creek, East Kootenay District, B.C.

Wycott Hydraulic Mining Company has been formed to take over, purchase and acquire a certain mining lease or leases, dated the 4th July, 1892, granted to James M. Harvey and Thos. J. Trapp, of New Westminster, B.C., and the water privileges in connection therewith; and to carry on the business of hydraulic or other process or processes of mining. Capital $500,000, in 50,000 shares of $10 each. The five Trustees are: S. K. Twigge, John Twigge, J. M. Spinks, M. M. Hirschberg, of Vancouver, and Thos. J. Trapp, of New Westminster, B.C. Head office is to be at Vancouver.

Tobique Valley Gypsum Mining & Manufacturing Co. Ltd. has been formed under Dominion charter with a Capital of $50,000, in shares of $100, to acquire and work Gypsum lands, in the Province of New Brunswick, and elsewhere in the Dominion of Canada, and to manufacture land plaster and other fertilizers. Head office, at Ottawa. The incorporators include the Hon. John Costigan, Secretary of State; G. P. Brophy, Ottawa; John Heney, Ottawa; Hon. H. G. Connell, Woodstock, N.B., and Henry A. Costigan, Winnipeg.

MANUFACTURING NOTE.

New Works of the Robb Engineering Co.

The works of the Robb Engineering Co., Ltd., which were swept by fire August 28th, 1890, have risen Phœnix like, till now this enterprising company is employing as many hands as before the fire, and when it is remembered that they have given up the manufacture of stoves altogether, only making the repair pieces, it will be evident that they are now pushing their engine and boiler business, machine work and hot air furnaces more extensively than before the fire. They employ 100 hands to whom they pay out a weekly sum amounting to $2,500 to $3,000 per month. They have lately moved into a large and well equipped brick moulding shop, which is 100 feet square and is fitted with two large swinging cranes for heavy work, patent Colliau cupola, large brick core oven, etc. Their boiler shop is 100 x 50 ft. and is fitted with overhead travelling cranes, besides a good outfit of boiler shop machinery. Their machine shops are 100 x 40 ft. (two flats) and are fitted with the best and latest machine tools for building high speed engines, heaters and power pumps, which they supply with their steam plants, and for doing general machine jobbing of all kinds. In addition to these shops, they have a large salesroom in which they carry a heavy stock of supplies, such as beltings, hose, packings, oils, iron pipe and fittings of brass and iron, etc., also engineers and sawyer's tools of every description, and in their commodious offices and drawing office are to be found every modern convenience. Their specialties are the Robb Armstrong engine, which is considered by competent judges to be the best engine yet introduced into Canada, and fully equal to the best produced in the United States, having all the parts interchangeable and embracing the best points in the leading American engines, also the Monarch Economic boiler, which not only gives very high economy, as its name suggests, but it is portable and has many other good points. These steam plants outfitted with heaters, and steam or power pumps of the latest design, they are sending to Ontario, Quebec and the North-West.

In proof of the foregoing it may be stated that they have placed one of their compound engines in Windsor, Ontario, which is running splendidly, and they have lately shipped one to Lethbridge, N.W.T. Twelve of these engines have been placed in Montreal alone, besides other places in Ontario and Quebec. Three of the Monarch Economic boilers were shipped for one plant alone, viz.: that of Windsor, Ontario, and the last of three more for London, Ontario, was shipped last week besides those that have been placed in Montreal and other places. In addition to these steam outfits they of course still supply sawmill machinery of all kinds.

Electrical Safety Apparatus for Cages—A description of an electrical safety apparatus for mine cages is given by Mr. J. Yates (Transactions of the Federated Institution of Mining Engineers, vol. ii., pp. 362-68, three plates). The requirements of a safety apparatus for mine cages are that it should never fail to act when required, and that it should not act unless the rope breaks; it should allow of being tested; it should be simple, and should not interfere with ordinary work. The apparatus consists of weighted levers, which are normally held out of action by horseshoe magnets, but which grip the guides through the medium of cams when liberated. A continuous current is used to keep the magnets excited, and this current is led to the magnets by two copper wires laid in the hemp core of the winding rope. The connection between these conductors and the battery is made by two brushes working on two copper rings on the drum shaft. This method of conveying an electric currrent to the cage has been successfully in use for some years for signalling purposes in the Durham district.

An illustration is given (*Electrical Review*, vol. xxix, p. 609), of a winding indicator worked by worm gearing from the drum shaft. Electric contacts are arranged on the dial, so that the pointer completes an alarm circuit when the cage is near the end of its travel, and thereby sounds an alarm bell. As the cage descends, the pointer lifts a spring and avoids making contact. The contact pieces are clamped in position by set screws, so that their position can be adjusted to suit the winding.

The Behaviour of Coal during Combustion—Mr. B. Holgate (lecture delivered before the Yorkshire College Engineering Society, December 7, 1891, through the *Colliery Guardian*, vol. lxii., p. 1014), described the variations of the behaviour of coal during combustion. Cannel coal contains a considerable quantity of fish remains, and was deposited under water. When coked, the lumps retained their original shape. Most other coals are somewhat similar in composition to one another, so that analysis alone will not determine their burning qualities. The appearance of the coal is a much better guide. Some coals require a high temperature and a strong draught to burn properly, such as the Better Bed coal of Yorkshire. As a general rule, coal which breaks naturally into small pieces will not deliver its gas so freely and will not burn so rapidly, but it makes the best coking coal when it is soft and breaks up easily. When the coal breaks into large lumps the gas can get away more readily.

The Manufacture of Nickel-Iron Alloys—Dr. H. Wedding (*Verhandlungen des Vereins zur Beforderung des Gewerbfleisses*, 1892, pp. 52-65), refer to the results of Riley's examination of the nickel-iron alloys. With regard to their mode of preparation, they may be made in blast furnaces with a mixture of oxide ores of iron and of nickel. The metal produced in this way is high in carbon, and is not suitable for conversion into malleable nickel-iron poor in carbon. On puddling such a carbon nickel-iron, oxides of nickel are formed, which are dissolved by the metal, and render it brittle to a much greater degree than would dissolved oxide of iron. To make a malleable nickel-iron alloy, metallic nickel must be added to the molton malleable iron. Nickel and iron do not form true alloys by themselves, but only mixtures, and to render these mixtures homogeneous some third metal, such as aluminium, must be added. Such experiments as have been from time to time recorded, which relate to the alloys of nickel and iron having far from exhausted the subject, the German Society of Arts is about to undertake a further and more detailed examination of these alloys. Viewed from the results of Riley's experiments, it would appear that the alloys best fitted for general use are those with less than 0.3 per cent. of carbon, and the percentage of nickel should not exceed about 5. What percentages of these two elements in the alloys are actually the best in the whole series has not as yet been shown, and information is wanting as to the real mechanical properties of the best of the alloys, and how they should best be handled. This too will form the subject of the investigation referred to.